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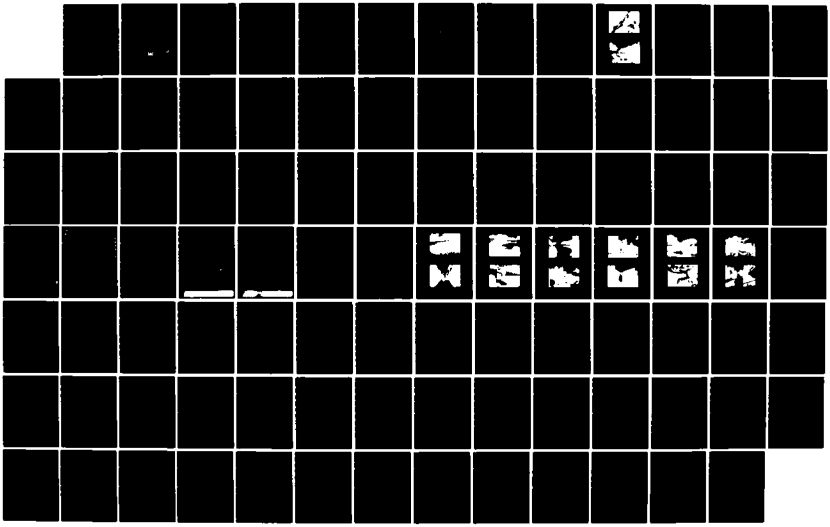

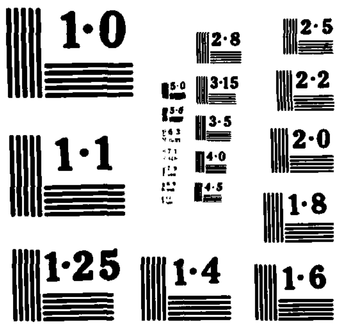

NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

PISCATAQUA RIVER BASIN

WAKEFIELD, NEW HAMPSHIRE

UNION MEADOWS DAM
N.H. 00222

STATE NO. 241.05

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

NOVEMBER 1979

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

JUL 22 1980

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Union Meadows Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00222
Name of Dam:	Union Meadows Dam
Town:	Wakefield
County and State:	Carroll County, New Hampshire
River:	Branch River
Date of Inspection:	September 19, 1979

BRIEF ASSESSMENT

Union Meadows Dam has a hydraulic height of 10 feet, is 8 feet wide, and is 67 feet long. It is a run-of-the-river, dry stone masonry and concrete dam with a concrete stoplog structure. The dam spans a reach of the Branch River and is located in east central New Hampshire. Maximum storage capacity is about 1,125 acre-feet. Union Meadows Dam is used for recreation. The pond is about 3,400 feet in length with a surface area of about 210 acres at normal pool.

The dam itself is generally in good condition. However, because of the inadequacy of the spillway and possible erosion of the west and east abutments, the overall condition is fair.

The dam is of intermediate size and significant hazard classification based on storage volume and potential for no loss of life but appreciable property damage in event of a breach. In accordance with Corps guidelines, the test flood may range from ½ to the Probable Maximum Flood (PMF). The ½ PMF was selected as the test flood because the storage volume is in the lower end of the range and there is little potential for loss of life in event of a breach. Union Meadows receives a test flood inflow of 19,400 cfs (624 csm) from a 31.1 square mile drainage area characterized by rolling terrain. After routing for surcharge storage, the routed test flood outflow of 18,000 cfs (579 csm) at elevation 508.1' MSL would overtop the dam by about 5.6 feet. Assuming a water surface at top of dam, the combination of the stoplog structure, principal spillway, and emergency spillway will pass 1,730 cfs or about 10 percent of the routed test flood outflow. Therefore, the spillway is considered inadequate.

The owner, the New Hampshire Water Resources Board, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan

Warren A. Guinan
Project Manager
N.H. P.E. 2339

This Phase I Inspection Report on Union Meadows Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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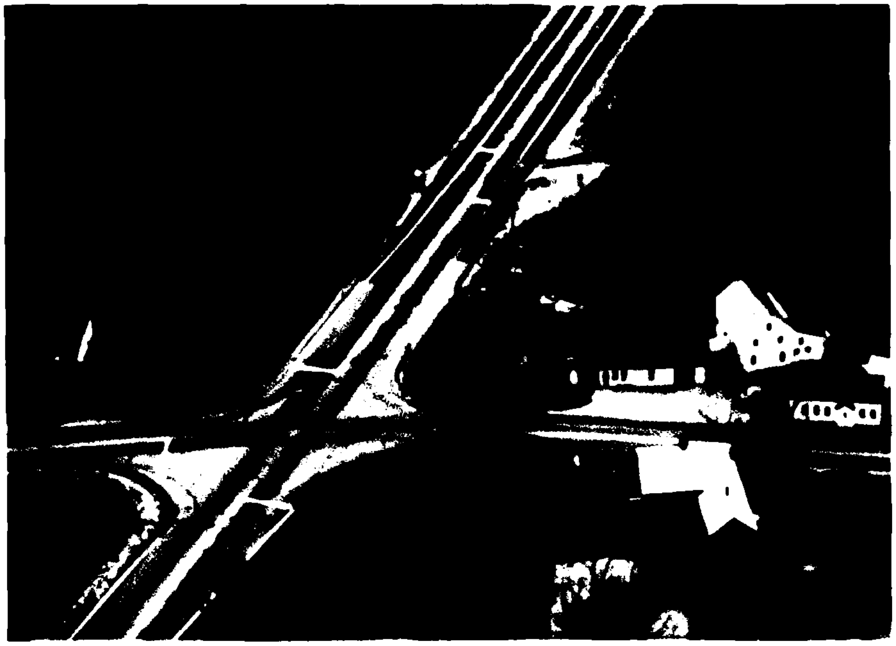
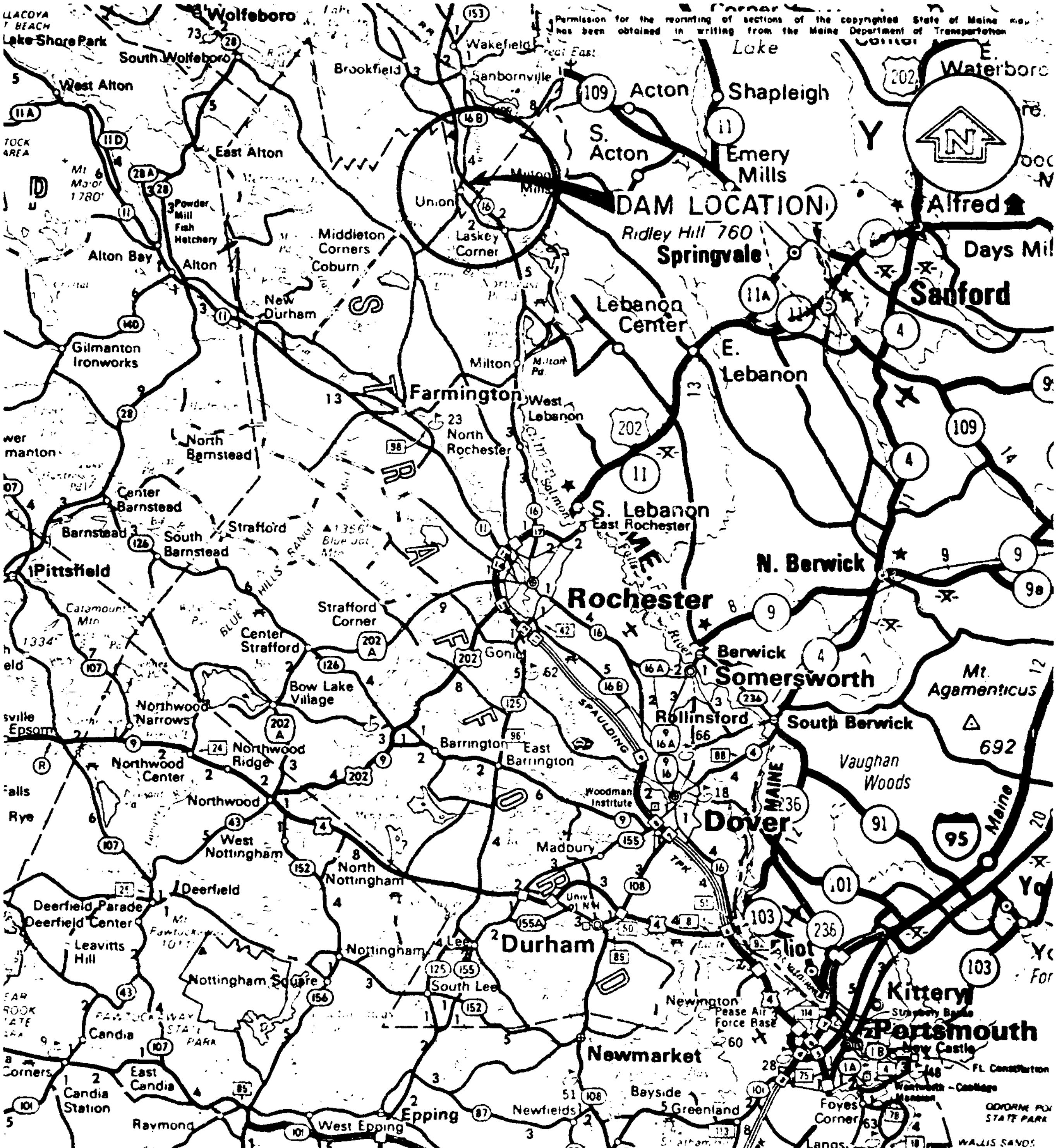


September 1979
Figure 1 - Overview of Union Meadows Dam. Note State Route 16 bridge just downstream.

September 19, 1979
Figure 2 - Close-up view of Union Meadows Dam from the State Route 16 bridge.



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MAP BASED ON STATE OF NEW HAMPSHIRE - STATE OF MAINE OFFICIAL HIGHWAY MAPS

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

UNION MEADOWS DAM LOCATION MAP

BRANCH RIVER NEW HAMPSHIRE

SCALE: 1" = 5 Mi

DATE: NOVEMBER 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
UNION MEADOWS DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of November 20, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract Number DACW33-79-C-0009, as changed, has been been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Union Meadows Dam is located in the Town of Wakefield, New Hampshire and impounds a reservoir of intermediate size. The dam spans a reach of the Branch River, a tributary of the Salmon Falls River. After discharging at the damsite, the Branch River flows southeasterly through mostly flat, partially wooded country to its confluence with the Salmon Falls River, a distance of about 5 miles. The Salmon Falls River is a major tributary in the Piscataqua River Basin. Union Meadows Dam is shown on U.S.G.S. Quadrangle, Wolfeboro, New Hampshire, with dam coordinates of approximately N43° 29' 55", W 71° 01' 35", Carroll County, New Hampshire. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Union Meadows Dam is a split stone masonry and concrete dam having a hydraulic and structural height of 10 feet. The total length of the dam is 67 feet, of which 60 feet consists of a concrete cap principal spillway. A stoplog structure is 7 feet long and located at the west end of the principal spillway.

The natural ground at the west side of the dam is grass covered and rises at a slope of about 10H:1V from a point flush with the top of the west abutment of the stoplog structure. The stoplog structure consists of two 12-inch thick concrete abutments each slotted to contain nine 3-inch by 8-inch by 5.5-foot stoplogs. The west abutment of the stoplog structure acts as a retaining/training wall and extends downstream from the dam a distance of about 25 feet.

A 3-foot wide by 12-inch thick concrete bridge connects the two abutments to facilitate placement and removal of stoplogs. The principal spillway runs from the east abutment of the stoplog structure to the east end of the dam, a distance of 60 feet. The crest of the principal spillway is 2.5 feet below the top of the stoplog structure abutments and has a concrete capped approach apron having a breadth of about 8 feet. This apron rests atop a dry stone-masonry base which extends vertically down to the downstream toe. Soil covered bedrock sloping up at about 2H:1V meets the principal spillway at the east end of the dam.

A dirt road follows the southern shoreline of Union Meadows. A low point in the road, located northeast about 3900 feet from the dam, acts as an emergency spillway during times of high water. The area upstream and downstream of the low section is quite swampy. The 10-foot wide dirt road rises upward on either side of the depression at a slope of about 20H:1V.

c. Size Classification. Intermediate (hydraulic height - 10 feet; storage - 1,125 acre-feet) based on storage (≥ 1000 to 50,000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant Hazard. A breach at top of dam probably would not result in loss of life but could cause appreciable property damage. (See Section 5.1 f.)

e. Ownership. Original ownership of Union Meadows Dam is unknown. Twin State Gas & Electric Company, Dover, New Hampshire, owned the dam until 1943. The dam was then sold to the Public Service Company of New Hampshire. Ownership remained unchanged until 1963 when the New Hampshire Water Resources Board, under the state (current owner), bought the dam for $1.00.

f. Operator. The current operator of the dam is the New Hampshire Water Resources Board (NHWRB), Mr. Vernon Knowlton, Chief Engineer, 37 Pleasant Street, Concord, New Hampshire, 03301. Phone (603) 271-3406.

g. Purpose of Dam. The dam was originally constructed to provide upstream storage for one of several small power companies located along the Salmon Falls River early in this century. The dam and its impoundment are presently used for recreational purposes.

h. Design and Construction History. Major renovations to Union Meadows Dam were completed in 1975. Three sets of proposed renovations were found in the files of the NHWRB. According to the dam as seen on the visual inspection, no one set of plans was utilized. Renovations included such items as removing timber on top of spillway and capping with concrete and construction of stoplog structure and training wall. Several dimensions were noted to be determined in the field.

i. Normal Operating Procedures. Stoplogs in the stoplog structure were used to regulate the level of Union Meadows. During the year, the dam is visited once every ten days by a maintenance staff member of the NHWRB. At this time conditions at the dam are checked and recorded in a log.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 31.1 square miles (19,904 acres) of rolling mountainous, mostly forested terrain. Five square miles of the total drainage area constitutes the Lovell Lake drainage area. The confluence of the outlet of Lovell Lake and the Branch River is located about 4 miles upstream of Union Meadows Dam. The surface area of Union Meadows at normal pool is 210 acres or about 1 percent of the total drainage area.

b. Discharge at Damsite

(1) Outlet works (conduits) - none

(2) The maximum discharge at the damsite is unknown.

(3) Ungated spillway capacity at top of dam -

principal spillway - 640 cfs @ 502.5' MSL
emergency spillway - 1025 cfs @ 502.5' MSL

(4) Ungated spillway capacity at test flood elevation -

principal spillway - 3734 cfs @ 508.1' MSL
emergency spillway - 11627 cfs @ 508.1' MSL

(5) Gated spillway capacity at top of dam: with stoplogs - 65 cfs, without stoplogs - 490 cfs @ 502.5' MSL

(6) Gated spillway capacity at test flood elevation: with stoplogs - 134 cfs @ 508.1' MSL

(7) Total spillway capacity at test flood elevation: with stoplogs -

stoplog opening - 134 cfs
principal spillway - 3734 cfs
emergency spillway - 11627 cfs @ 508.1' MSL

(8) Total project discharge at test flood elevation: with stoplogs - 18,000 cfs @ 508.1' MSL

c. Elevation (ft. above NGVD of 1929, formerly called Mean Sea Level Datum (MSL); see (4) below)

(1) Streambed at centerline of dam - 492.3 (downstream toe)

(2) Maximum tailwater - unknown

(3) Upstream portal - not applicable

(4) Recreation pool - 500.0 (top of principal spillway assumed from USGS quad sheet)

(5) Full flood control pool - not applicable

(6) Stoplog opening sill - 494.4 (stoplogs removed)

(7) Original design surcharge - unknown

(8) Top of dam - 502.5

(9) Test flood pool - 508.1

d. Reservoir Length (miles)

(1) Maximum pool - 0.8

(2) Recreation pool - 0.6

(3) Flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 510

(2) Flood control pool - not applicable

(3) Spillway crest pool - 300

(4) Top of dam - 1125

(5) Test flood pool - 2859

f. Reservoir Surface Area (acres)

(1) Recreation pool - 210

(2) Flood control pool - not applicable

(3) Spillway crest - 210

(4) Test flood pool - 332

(5) Top of dam - 300

g. Dam

(1) Type - dry stone-masonry with concrete capped principal spillway approach apron; concrete stoplog structure.

(2) Length - 67'

(3) Height - 10' (structural and hydraulic height)

(4) Top width - 8' (principal spillway approach apron)

(5) Side slopes - upstream, 4H:1V; downstream vertical.

(6) Zoning - not applicable

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable (See j. below.)

i. Spillway

(1) Type: stoplog opening - concrete with 3-inch thick stoplogs; principal spillway - concrete with 8-foot wide approach apron; emergency spillway - 10-foot wide dirt road.

(2) Length of weir: stoplog opening - 5'; principal spillway - 60'; emergency spillway - 60' (at crest - length increases with increase in head)

(3) Crest elevation: stoplog opening - 500.0' MSL (top of stoplogs) without stoplogs - 494.4' MSL; principal spillway - 500.0' MSL; emergency spillway - 500.0' MSL.

(4) Gates - nine stoplogs

(5) U/S Channel - Union Meadows Reservoir is essentially an enlargement in the Branch River. The 250 feet of channel immediately upstream of the dam consists of a narrow lagoon. Union Meadows then spreads out to form a relatively large body of water further upstream. A B&M railroad bridge crosses the lagoon about 130 feet upstream of the dam. Banks alternate between tree-lined and grassed. The lagoon is about 70 feet wide with sideslopes of about 5H:1V.

(6) D/S Channel - The Branch River. Immediately below the dam the channel is about 50 feet wide with a rocky bottom. The east bank is brush covered with some trees and slopes up at about 2H:1V. The west bank consists of a concrete training wall that extends a distance of about 25 feet downstream from the dam. The bank downstream of this wall is grass covered and also slopes up at about 2H:1V. A large highway bridge carries State Route 16 over the Branch River about 150 feet downstream of the dam.

Three additional dams span the Branch River downstream of Union Meadows Dam in the one mile reach which passes through the Village of Union. The banks of this reach are largely residential.

j. Regulating Outlets.

The stoplog structure essentially acts as a regulating outlet. The stoplogs can be removed to control flow as well as regulate the reservoir level.

SECTION 2
ENGINEERING DATA

2.1 Design

Three sets of design plans for proposed renovations at Union Meadows Dam were found in the files of the New Hampshire Water Resources Board. However, the NHWRB does not know which set of plans, if any, were implemented in the renovations which were completed in 1975. Examination of these plans, in reference to what was observed on the visual inspection, renovations included such items as removing timber on top of the spillway and capping with concrete and construction of the stoplog spillway structure and training wall. Several dimensions were noted to be determined in the field. All other dimensions were noted preliminary and subject to revision once the pond was drained.

2.2 Construction

No construction data were found for Union Meadows Dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Very little engineering data were accessible.

b. Adequacy. The final assessments and recommendations of this investigation are based on the visual inspection and the hydrologic and hydraulic calculations.

c. Validity. Not applicable.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Union Meadows Dam is a low dam which impounds a reservoir of intermediate size. The watershed above the reservoir is rolling and partially wooded. The downstream area is rolling and several buildings and bridges are located along the valley bottom.

b. Dam. Union Meadows Dam is a concrete-capped dry stone-masonry dam, 10 feet high, 67 feet long, and 8 feet wide at the crest. (See Appendix C - Figure 2.) The concrete cap and dry stone-masonry appear to be in good condition. (See Appendix C - Figure 3.) Soil covered bedrock is exposed at the east abutment. (See Appendix C - Figure 4.) No evidence of seepage through the abutment or deterioration of the abutment rock was observed.

The west abutment is grass covered earth. A concrete training wall extends 25 feet downstream from the abutment along the west side of the downstream channel. (See Appendix C - Figure 5.) No evidence of seepage through the abutment was observed. A stoplog structure is located adjacent to the west end of the principal spillway. (See Appendix C - Figure 6.)

A low point in the dirt road at the southeast side of the reservoir acts as an emergency spillway. On a subsequent inspection on November 5, 1979 about 0.6 foot of water was flowing over the road and functioning as an emergency spillway. Upstream and downstream of the road, the terrain is partially wooded swamp.

c. Appurtenant Structures. A concrete stoplog structure, 5 feet wide with a sill elevation 5½ feet below the crest of the overflow section of the dam is located at the west end of the dam. (See Appendix C - Figure 4.) The concrete is in good condition, with loss of surface laitance only in the stoplog slots. The stoplogs are 3" x 8" treated timbers and are in good condition. The steel handrailing on the deck over the stoplog opening is painted and has only minor areas of surface rusting.

d. Reservoir Area. The watershed above the reservoir is rolling and partially wooded. Sand and gravel have accumulated against the upstream side of the dam to within about 2 feet of the crest of the overflow section of the dam, except in the approach channel upstream of the stoplog spillway.

e. Downstream Channel. The bottom of the downstream channel is covered with sand, gravel, and boulders. Trees overhang the east bank of the channel between the dam and the highway bridge immediately downstream of the dam. (See Appendix C - Figure 7.)

3.2 Evaluation

Based on the visual inspection, Union Meadows Dam is in good

condition. Trees growing on the east bank of the discharge channel between the dam and State Route 16 would obstruct the channel and the culvert downstream if they should fall over during floodflow conditions.

A potential for erosion exists at the west and east abutments of the dam if overtopping should occur.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures exist for Union Meadows Dam. The New Hampshire Water Resources Board (NHWRB) inspects the dam about once every ten days. Seasonal drawdown of Union Meadows is not a normal procedure.

4.2 Maintenance of Dam

Maintenance of the dam is performed as required by the NHWRB.

4.3 Maintenance of Operating Facilities

See 4.2 above.

4.4 Description of Warning System in Effect

No warning system exists for the dam.

4.5 Evaluation

Frequent inspection by the NHWRB and the relative non-complexity of the dam preclude any need for more stringent operational procedures.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Union Meadows Dam is a dry stone-masonry and concrete dam which impounds a reservoir of intermediate size. The total length of the dam is 67 feet. The 60-foot wide principal spillway has an 8-foot wide concrete cap that acts as an approach apron. The stoplog structure is 7 feet long and is located at the west end of the dam. The 5-foot long stoplog weir is used to control the level of the reservoir. The 60-foot long emergency spillway is located on the southeastern side of the reservoir. It consists of a 10-foot wide dirt road whose crest elevation is equal to that of the principal spillway. Union Meadows Dam is located on the Branch River.

b. Design Data. No hydrologic or hydraulic design data were found.

c. Experience Data. No data concerning previous overtopping at Union Meadows Dam were disclosed.

d. Visual Observations. At the time of inspection, no visual evidence of damage to the dam caused by excessive discharges was noted.

e. Test Flood Analysis. Union Meadows Dam is classified as intermediate, having a hydraulic height of 10 feet and a maximum storage capacity of 1,125 acre-feet. The dam impounds an enlargement of the Branch River, containing runoff from a 31.1 square mile drainage area which includes the 5-square-mile Lovell Lake drainage area. Using a csm value of 1,370 for the rolling, mostly forested terrain, a Probable Maximum Flood (PMF) of 38,800 cfs was obtained.

Because of the dam's intermediate size and significant hazard classification, the Recommended Guidelines for Safety Inspection of Dams dictated a range of ½ PMF to PMF from which to choose the test flood. Because the dam's size is near the lower end of the intermediate size range, the test flood was chosed to be ½ the PMF.

Using ½ PMF, the test flood inflow was determined to be 19,400 cfs. This value was obtained by summing an inflow of 17,900 from 26.1 square miles of upstream drainage area and a routed outflow of 1,525 cfs from the outlet of the 5-square mile Lovell Lake drainage area. After reservoir routing with stoplogs in place, the test flood discharge was calculated to be 18,000 cfs at Union Meadows Dam. The overtopping analysis indicates that the dam would be overtopped by 5.6 feet during the test flood at elevation 508.1' MSL. The maximum spillway capacity at top of dam with stoplogs in place (including emergency spillway) is 1,730 cfs or about 10 percent of the test flood discharge. Therefore, the capacity of the spillway is considered inadequate.

f. Dam Failure Analysis. The impact of failure of the dam with the reservoir level at top of dam was assessed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam a distance of about 2,000 feet downstream through the inhabited area of Union, New Hampshire. Little development is located downstream of this area. Outflow from the emergency spillway enters the Branch River downstream of the hazard reach located in the Village of Union. Therefore, this flow is not considered in determining the downstream hazard. Two bridges, one dam, and several inhabited structures are located within the hazard reach. (See Appendix D, D-15.) Antecedent discharge just prior to failure would be about 745 cfs. A major breach of the dam would result in a breach discharge of about 2,430 cfs. A breach at top of dam would raise the stage through the Route 16 bridge culvert by about 3 feet in addition to the 3-foot antecedent stage. No significant damage to the culvert is likely to occur. The breach wave then moves through Reach 2 as shown in Appendix D, D-15. An increase in stage of about 3 feet (foundation elevation) in addition to the 2.5-foot antecedent stage could result in minor flooding (less than 2 feet) at the sills of two inhabited structures. Since these sills are 6-8 feet lower than the first floors of the structures, potential for loss of life is nil. Some minor damage could occur. Dam "A", as shown in Appendix D, D-15 is the next obstruction to flow encountered. The breach wave would cause an increase in stage of about 2 feet, bringing the total stage to about 4 feet above the top of dam as shown on p. D-26. Some damage to the dam could occur but little damage to the overbanks is likely. Reach 3 downstream of Dam "A" would be subjected to a total stage of 8.3 feet. Flooding to a depth of about 2 feet on two uninhabited structures could occur. The Maple Street bridge culvert is located about 130 feet downstream of Dam "A". This culvert would carry the total breach flow of 2,430 cfs without overtopping of Maple Street. After moving through the culvert, flooding would enter Reach 4. An increase in stage of about 4 feet in addition to the 3-foot antecedent stage would cause about 3 feet of flooding in one inhabited structure. Minor damage could result but loss of life would probably not occur. Based on the above analysis, Union Meadows Dam is classified as Significant Hazard.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. No evidence of structural problems was observed.

b. Design and Construction Data. No design and construction data are available.

c. Operating Records. No operating records pertinent to the structural stability are available.

d. Post-Construction Changes. Renovations were completed in 1975, which consisted of capping the crest of the spillway with concrete and construction of the stoplog structure and training wall.

e. Seismic Stability. This dam is located in Seismic Zone 2 and in accordance with the Phase I Guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Union Meadows Dam is generally in good condition. However, because of the following concerns the overall condition is fair. The concerns with regard to the integrity of the dam, if left uncorrected, are:

(1) The inadequately sized spillway.

(2) Possible erosion of the west and east abutments.

(3) Trees overhanging the discharge channel may blow over into the channel or drop over into the channel as a result of erosion during periods of high discharge from the reservoir. These trees could cause temporary damming of the channel or they may plug bridges or culverts downstream.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in Section 7.2 should be implemented by the owner within one year after receipt of this Phase I report.

d. Need for Additional Investigation. Additional studies of hydrology and hydraulics are needed. Additional studies of the composition of the west and east abutments are also needed.

7.2 Recommendations

The owner should engage a qualified registered engineer to:

(1) Conduct a detailed hydrologic analysis of the spillway adequacy and to increase spillway capacity if the analysis so indicates.

(2) Design procedures to prevent erosion of the west and east abutments.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Clear the trees for a distance of 25 feet from the east bank of the downstream channel between the dam and the highway bridge.

(2) Visually inspect the dam once a month.

(3) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once every two years.

(4) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency conditions.

7.4 Alternatives

None.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Union Meadows Dam, N.H.

DATE September 19, 1979

TIME 0900

WEATHER Partly sunny, cool

W.S. ELEV. U.S. ______ DN.S. ______

PARTY:

1. Warren Guinan (ANCo)
2. Stephen Gilman (ANCo)
3. Augustine Sharry (ANCo)
4. Ronald C. Hirschfeld (GEI)
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan/G. Sharry	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Union Meadows Dam, N.H. DATE September 19, 1979

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Stoplog section at west end of dam.
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Sand, gravel, and boulders. Abandoned piece of concrete formwork about 10 feet from west bank of upstream channel partially prevents accumulation of sand and gravel upstream of stoplog section.
Rock Slides or Falls	None
Log Boom	None visible
Debris	None visible
Condition of Concrete Lining	
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	Slots: 4" x 4" - erosion of surface laitance only Stoplogs: 3½" x 7½" treated wood - good condition

PERIODIC INSPECTION CHECKLIST

PROJECT Union Meadows Dam, N.H. DATE September 19, 1979

PROJECT FEATURE Stoplog Facility NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Stoplog Facility
a. Concrete and Structural	
General Condition	Good - only erosion of surface laitance
Condition of Joints	Good - no indication of movement
Spalling	None visible
Visible Reinforcing	None
Rusting or Staining of Concrete	None visible
Any Seepage or Efflorescence	None
Joint Alignment	Good - no indication of movement
Unusual Seepage or Leaks in Gate Chamber	None visible through stoplogs
Cracks	None visible
Rusting or Corrosion of Steel	None visible
b. Mechanical and Electrical	Not applicable
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Union Meadows Dam, N.H. DATE September 19, 1979

PROJECT FEATURE Principal spillway NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	PRINCIPAL SPILLWAY
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some trees overhanging channel.
Floor of Approach Channel	Sand and gravel which has accumulated to within about 2 ft. of crest of dam.
b. Weir and Training Walls	Concrete capped dry stone masonry
General Condition of Concrete	Good
Rust or Staining	None visible
Spalling	None visible
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some trees overhanging east bank between dam and Route 16 highway bridge.
Floor of Channel	Sand, gravel, and boulders.
Other Obstructions	Route 16 highway bridge

PERIODIC INSPECTION CHECKLIST

PROJECT Union Meadows Dam, N.H. DATE September 19, 1979

PROJECT FEATURE Deck over stoplog facility NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	
Bearings	Not applicable
Anchor Bolts	Not applicable
Bridge Seat	Concrete - good condition
Longitudinal Members	Concrete deck
Underside of Deck	Good - no indication of deterioration of concrete.
Secondary Bracing	Not applicable
Deck	Good
Drainage System	Not applicable
Railings	Good condition
Expansion Joints	Not applicable
Paint	Good - only minor surface rust.
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

THE STATE OF NEW HAMPSHIRE

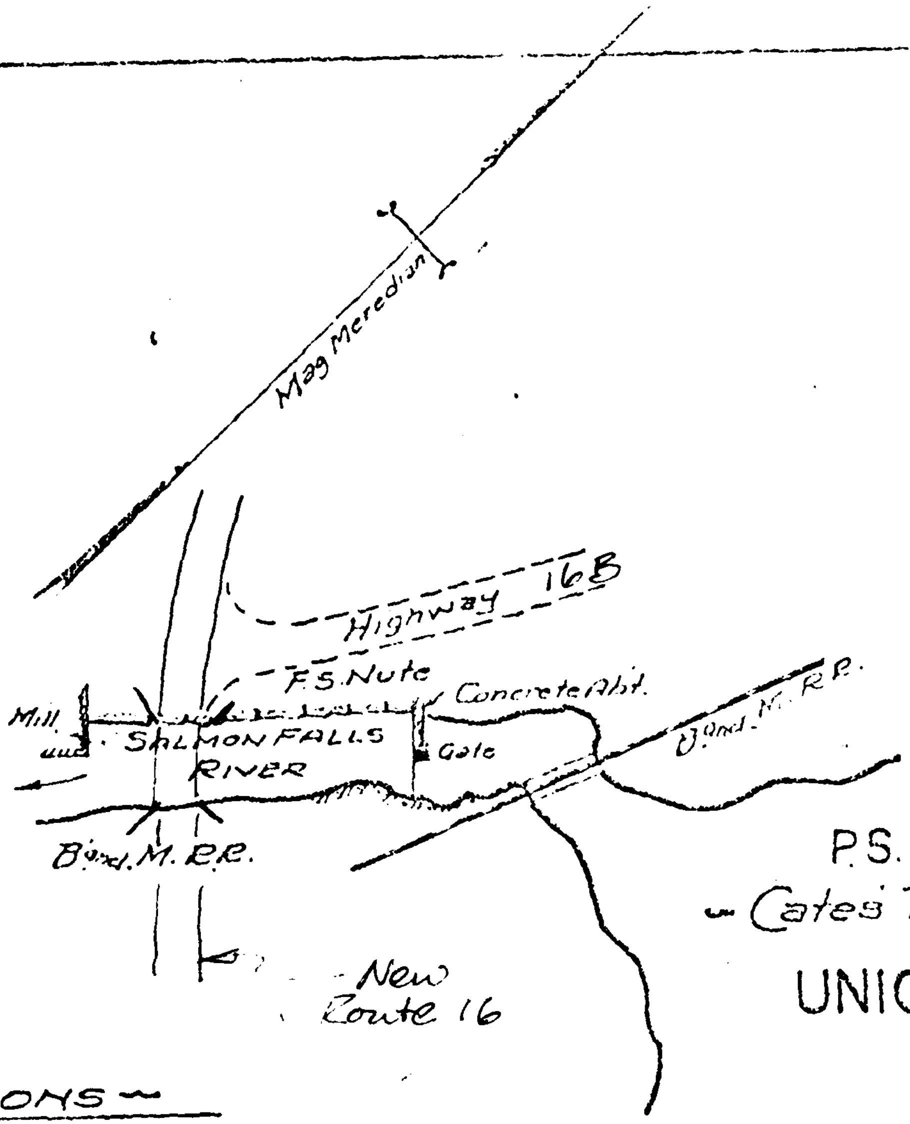
WATER RESOURCES BOARD

37 Pleasant Street Concord, New Hampshire

- NEWS RELEASE -

George M. McGee, Sr., Chairman of the New Hampshire Water Resources Board, announces that the level of Union Meadows Pond in Wakefield will be lowered up to seven feet beginning on October 1, 1974, to enable the Water Resources Board to make extensive repairs to the dam during the winter months.

All persons whose wells may be affected by the lowering of the water are urged to take precautions to insure them an adequate water supply during the construction period. This lowering of the pond will offer the opportunity to property owners on the pond frontage to make necessary maintenance repairs to their shoreline structures. They are cautioned, however, that prior to undertaking such projects, they must secure a Fill and Dredge permit from the Special Board. Applications can be obtained by writing to George M. McGee, Sr., Chairman, N. H. Special Board, 37 Pleasant Street, Concord, New Hampshire, 03301.



P.S.CO. LAND
– Cates Reservoir –
OR
UNION MEADOWS

– ELEVATIONS –

B.M. N.E. Cor. Abut.	10.00
W.S. Above Dam	7.49
Crest Dam	6.94
W.S. Below Dam	5.31
River Bed Above Gate	–0.50

SCALE 1" – 10 RODS

DB160

DAM #241.65

DATE November 14, 1968

FROM Francis C. Moore FCM

SUBJECT Leak at Union Meadows Dam

TO Vernon A. Knowlton

On the morning of November 14, 1968, I visited Union Meadow dam to check a leak on the left abutment of the spillway. The water level was 2.45' below the west concrete abutment with 0.55' head on the spillway. Flow was about 66 c.f.s. from a 31 square mile drainage area.

The leak appears to be the result of loss of 2 or 3 planks on the upstream face of the spillway. This allows a slot below the spillway crest about 18" horizontally and about 6" to 8" vertically. This hole is against the ledge abutment.

To correct this, there are at least three possible ways:

(1) Draw the pond down about three feet and replace the plank, fitting them to the ledge abutment.

(2) Place loose bags filled with 1.3 cement mortar to plug the hole. about 2 bags of cement and 6 bags of sand would be needed to fill the sand bags.

(3) Same as above but omit the cement.

This repair does not appear to be an emergency requiring immediate attention. However, late fall is probably the best time to do it. Even in summer, Union Meadow should refill.

FCM/jb

UNION MEADOWS POND (Cates Reservoir) DATA

Union, N. H. (Wakefield) Dam #241.05

Dam purchased from Public Service Company for $1.00 on December 18, 1963

Drainage Area: 32.3 square miles

Pond Area: 300 acres

Upstream Ponds Area: 787 acres

1" runoff raises lake 69.0" 860 c.f.s. days

Type of Dam: Gravity, Ledge, Boulders, Timbers

Dam Length: 87' (spillway 48')

Full lake level - spillway crest

Gate sill to spillway crest - 6'

15-year flood frequency: 1150 c.f.s.

100-year flood frequency: 2460 c.f.s.

2 Gates: 54" high
40" wide

Maximum gate discharge (full lake + 36"): 460 c.f.s. (both gates)

Maximum spillway discharge (full lake + 36"): 820 c.f.s.

Maximum Total Discharge 1280 c.f.s.

Freeboard: 36" maximum

See Curve for Spillway Discharge

See Curve for Gate Discharge

NOTE: When distance from platform to top of gate stem is 2'6", the gates are closed.

WEK
9/9/64

STATE OF NEW HAMPSHIRE

INTER--DEPARTMENT COMMUNICATION

DATE September 28, 1949

AT (OFFICE)

FROM

Francis J. Lariviere
Assoc. Sanitary Engineer
Div. of Sanitary Engineering

SUBJECT

Lowering of Water Levels at Union Meadows, Union, N. H.

TO

Walter G. White
Water Resources Board
State House Annex

A complaint has been received from residents of Union Meadows located near an enlargement of the Branch River approximately 1 1/4 miles No. of Union Village on Route 16 in the Town of Wakefield. The complaint states that a public health nuisance has been created because of lowering of the water level at Union Meadows and creating mud flats giving rise to the production of objectionable odors. An investigation was made on September 14, and disclosed that the level of this body of water is controlled by an electric utility having flowage rights at the dam located in Union Village.

Conversation with Mr. Garside, located near the affected area, disclosed that the level was lowered on August 15 of this year and allowed to return back to normal on September 14.

Inasmuch as this involves the matter of flowage rights as well as a public health nuisance we feel that it should be brought to your attention for whatever action you deem necessary.

Francis J. Lariviere

Francis J. Lariviere
Assoc. Sanitary Engineer

FJL/des

NEW HAMPSHIRE WATER CONTROL COMMISSION

DATA ON DAMS IN NEW HAMPSHIRE

STATE NO. 241.05

LOCATION

Town Wakefield : County Carroll

Stream Branch River

Basin-Primary Piscataqua R. : Secondary Salmon Falls R.

Local Name Union Meadows(Gates Pond)?

Coordinates—Lat. : Long.

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 32.09 Sq. Mi.

Overall length of dam 87 ft.: Date of Construction

Height: Stream bed to highest elev. 11.417 ft.: Max. Structure 8.417 ft.

Cost—Dam : Reservoir

DESCRIPTION Gravity, Boulders Timber, concrete. Earth Ledge Found.

Waste Gates

Type (Gates &Gate Stem Rotten)

Number 1 : Size 4.5 ft. high x 40"wide ft. wide

Elevation Invert : Total Area sq. ft.

Hoist

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment

Type

Height—Max. ft.: Min. ft.

Top—Width : Elev. ft.

Slopes—Upstream on : Downstream on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction Ledge, Boulders , Timbers

Length—Total 48.163 ft.: Net ft.

Height of permanent section—Max. 8.417 ft.: Min. ft.

Flashboards—Type none : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials: Boulders

Freeboard: Max. 3 ft.: Min. ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Public Service Co., of NH.

REMARKS Use Conservation

Tabulation By RLT Date 9/20/39

EMB1284

DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE

LOCATION AT DAM NO. 241.05

Town Wakefield : County Carroll

Stream Branch River

Basin—Primary Piscataqua R. : Secondary Salmon Falls R.

Local Name Union Meadow (Gates Pond)?

DRAINAGE AREA

Controlled .... Sq. Mi.: Uncontrolled .... Sq. Mi.: Total 32.09 Sq. Mi.

ELEVATION vs. WATER SURFACE AREA vs. VOLUME

Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1) Max. Flood Height			
(2) Top of Flashboards			
(3) Permanent Crest		(49.47SRB)	
(4) Normal Drawdown	3 P.S.Co	300P.S.C.	361P.S.C.
(5) Max. Drawdown			
(6) Original Pond			

Base Used ....: Coef. to change to U.S.G.S. Base ....

RESERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdown	ft.	ft.
Volume	ac. ft.	ac. ft.
Acre ft. per sq. mi.		
Inches per sq. mi.		

USE OF WATER Conservation

OWNER Public Service Co., of NH. Union, NH.

REMARKS Menace,

Tabulation By .... Date ....

UBLIC SERVICE COMMISSION OF NEW HAMPSHIRE DAM RECORD I-4803

N	Wakefield	TOWN NO	5
		STATE NO	
ER STREAM	Branch River		
DRAINAGE AREA	32.03 Sq. Mi.	POND AREA	
DAM TYPE	Gravity	FOUNDATION NATURE OF	Earth, Ledge
MATERIALS OF CONSTRUCTION	Boulders, Timber, Concrete		
PURPOSE OF DAM	POWER—CONSERVATION DOMESTIC RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM	11'-5"	TOP OF DAM TO SPILLWAY CREST	3'
SPILLWAYS LENGTHS DEPTHS BELOW TOP OF DAM	13'-4", 34'-10"	LENGTH OF DAM	87'
FLASHBOARDS TYPE HEIGHT ABOVE CREST	None		
OPERATING HEAD CREST TO N. T. W.		TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.			
GENERATORS, NUMBER KINDS & K. W.			
H. P. 90 P. C. TIME 100 P. C. EFF.		H. P. 75 P.C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS, INSPECTIONS			
REMARKS			

ER- Public Service Company

CONDITION- Fair. Should have new gates and stems.

MENACE- Yes. Will be subject to periodic inspection.

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made October 2, 1935, according to notification to owner dated September 27, 1935, and bill for same is enclosed.

Samuel J. Lord
Hyd. Eng.

Oct. 8, 1935
Copy to Owner

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

TOWN	NO. 332.3 P.S.C.A.
RIVER	DR.A.SQ.MI.
	OWNER
LOCAL NAME OF DAM *Union Meadows (Gates ...)*	
	DESCRIPTION

POND AREA-ACRES 42.47 DRAWDOWN FT. 3 POND CAPACITY-ACRE FT. 361

HEIGHT OF DAM-FT. 84 MAX. MIN.

ELEV. U.S.G.S.	LOCAL GAGE
ELEV. U.S.G.S.	LOCAL GAGE
	FREEBOARD-FT.

26 cfs ... storage at 8 ft ...

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE

Copy

September 27, [illegible]

Public Service Co. of N.H. owned [illegible] dam in Oct. '35?

Twin State Gas & Electric Company
Dover, New Hampshire

Gentlemen:

Pursuant to the duty imposed upon it by chapter 218 of the Public Laws of New Hampshire, the Public Service Commission will inspect the dams in the vicinity of Wakefield, on October 2, 1935.

Town Records indicate that you are the owner of three dams in the town of Wakefield, which will be inspected on the above mentioned date. We should be pleased to have you or your representative present during this inspection.

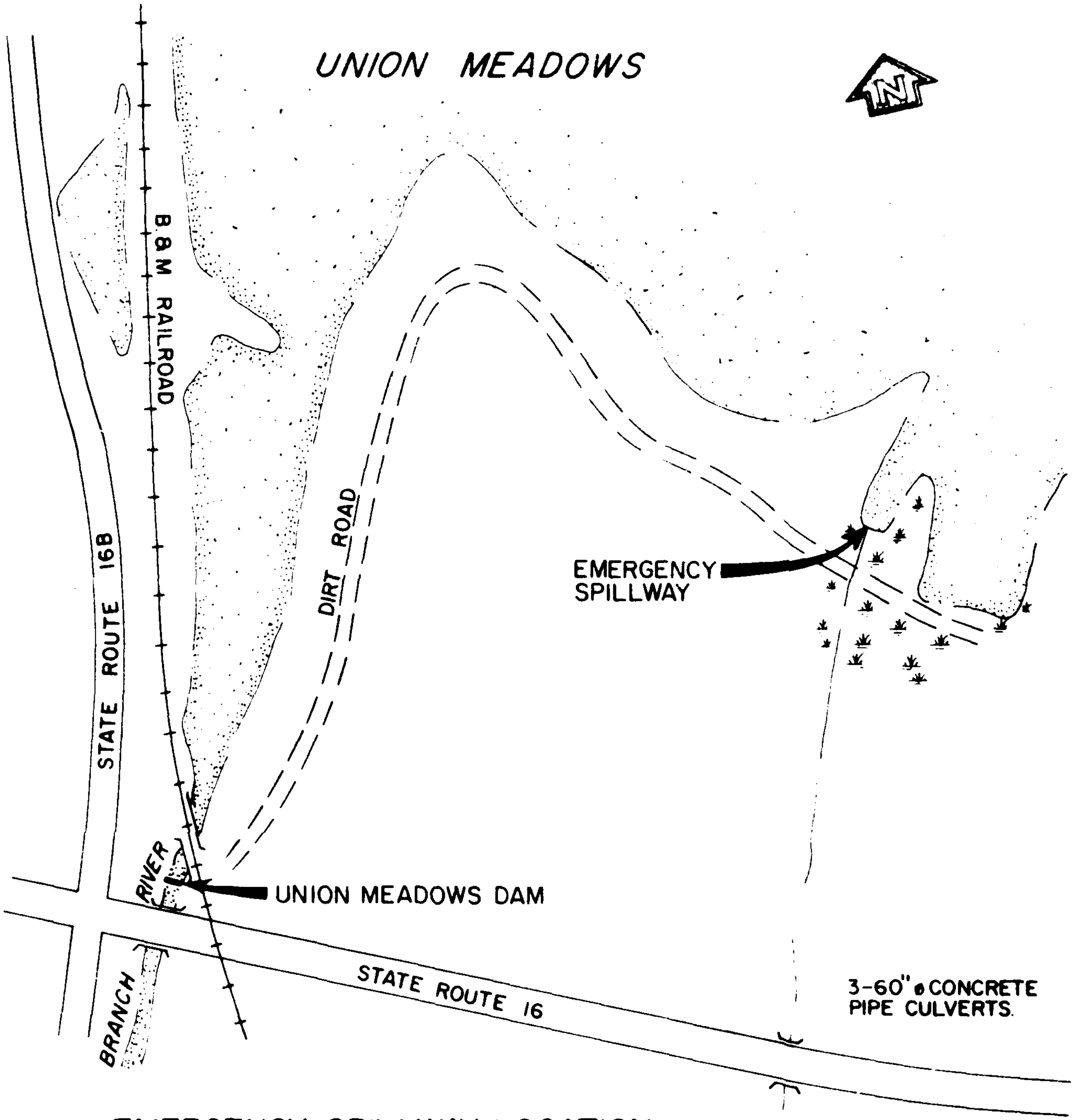
Under the statute all dams in your vicinity will be inspected to determine whether or not they would be a menace to the public safety if improperly maintained. Dams which would not be a menace to the public safety will not be subject to a later periodic inspection. It is our intention to inspect dams which would be a menace to the public safety if improperly maintained about once every five years.

There will be a nominal charge for each dam inspected, which we will endeavor to keep as reasonable as possible consistent with a competent inspection. Our inspector is an expert on dam construction and maintenance, and since you will be charged for his inspection we hope you will be able to be present when he views your dam so that you may avail yourself of his services.

Very truly yours,

N. H. PUBLIC SERVICE COMMISSION

Samuel J. Lord
Hyd. Eng.



EMERGENCY SPILLWAY LOCATION

NOTE:
See folowing Plate (Plan & Elevation) For Detail of Union Meadows Dam

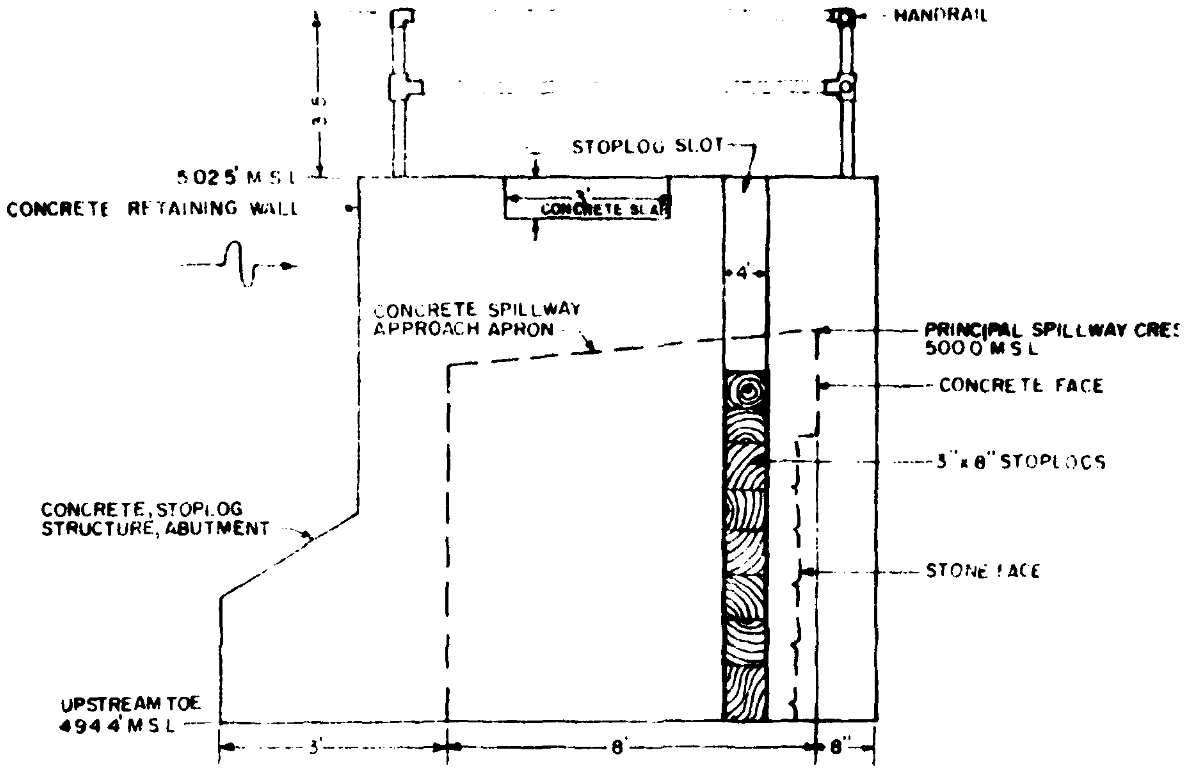
Anderson-Nichols & Co, Inc CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

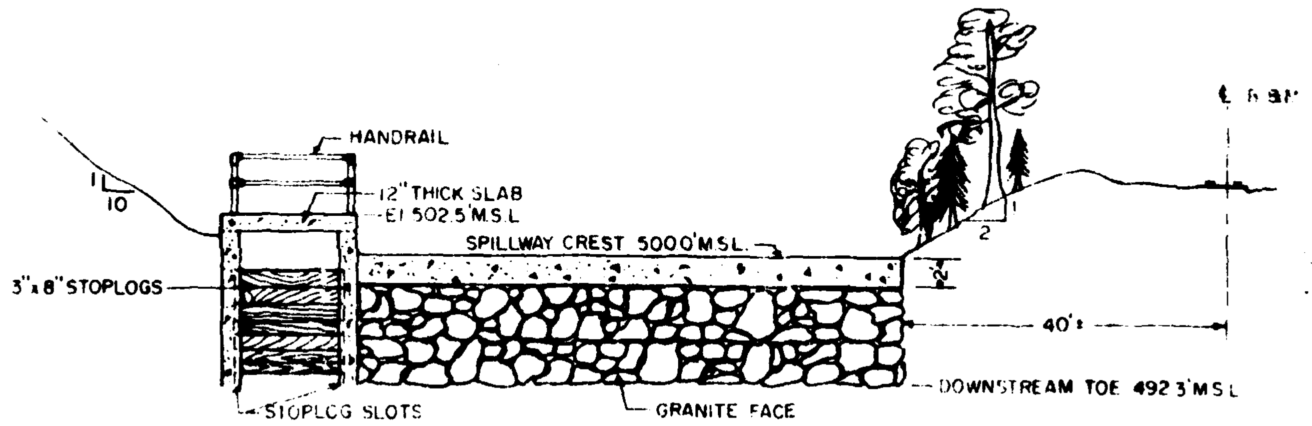
UNION MEADOWS DAM

BRANCH RIVER NEW HAMPSHIRE

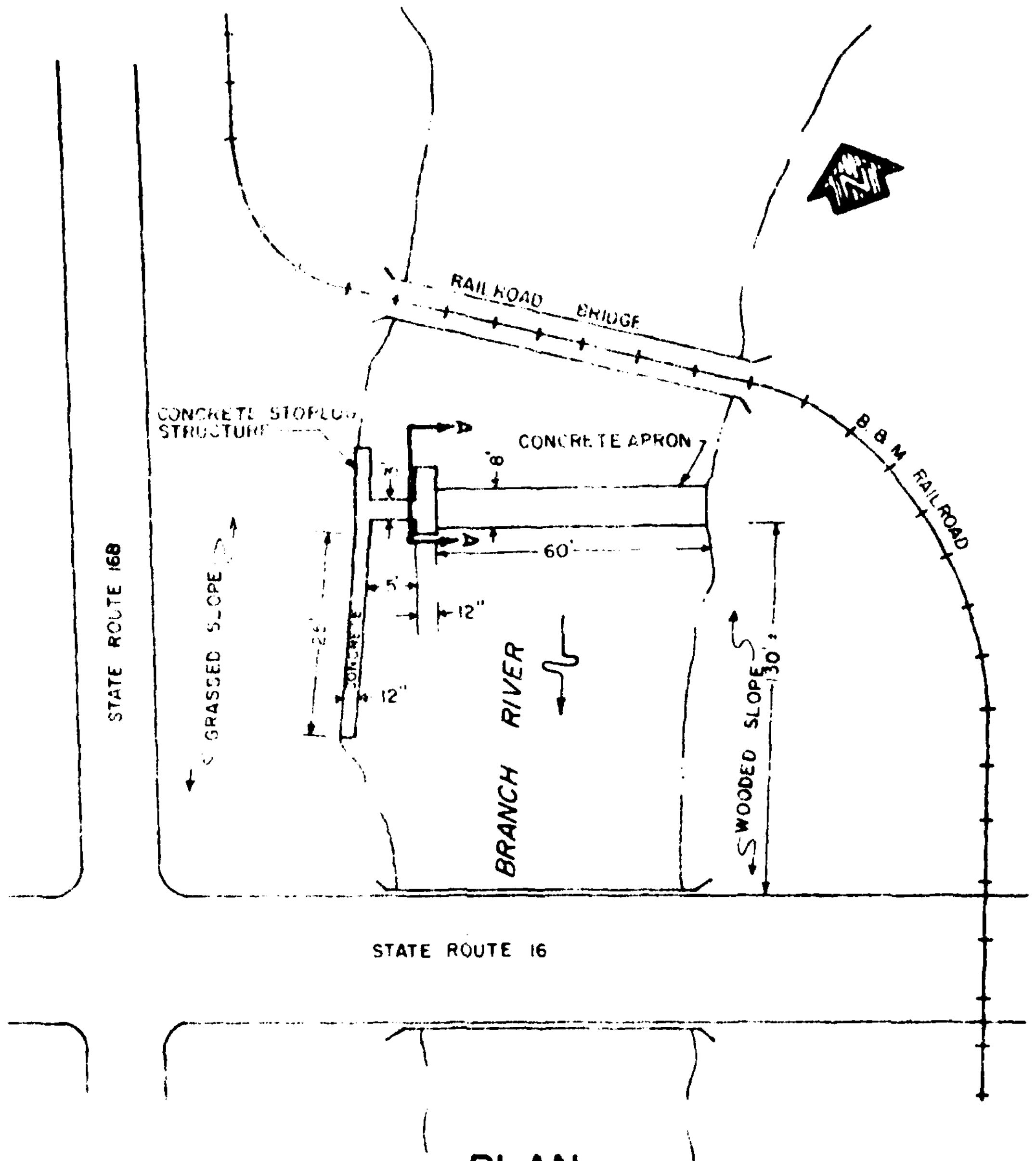
			SCALE NOT TO SCALE
			DATE NOVEMBER 1979



SECTION A-A



ELEVATION



PLAN

NOTE: ALL ELEVATIONS ARE RELATIVE TO ASSUMED SPILLWAY CREST ELEVATION OF 500.0 M.S.L. DATUM (N.G.V.D.)

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

UNION MEADOWS DAM

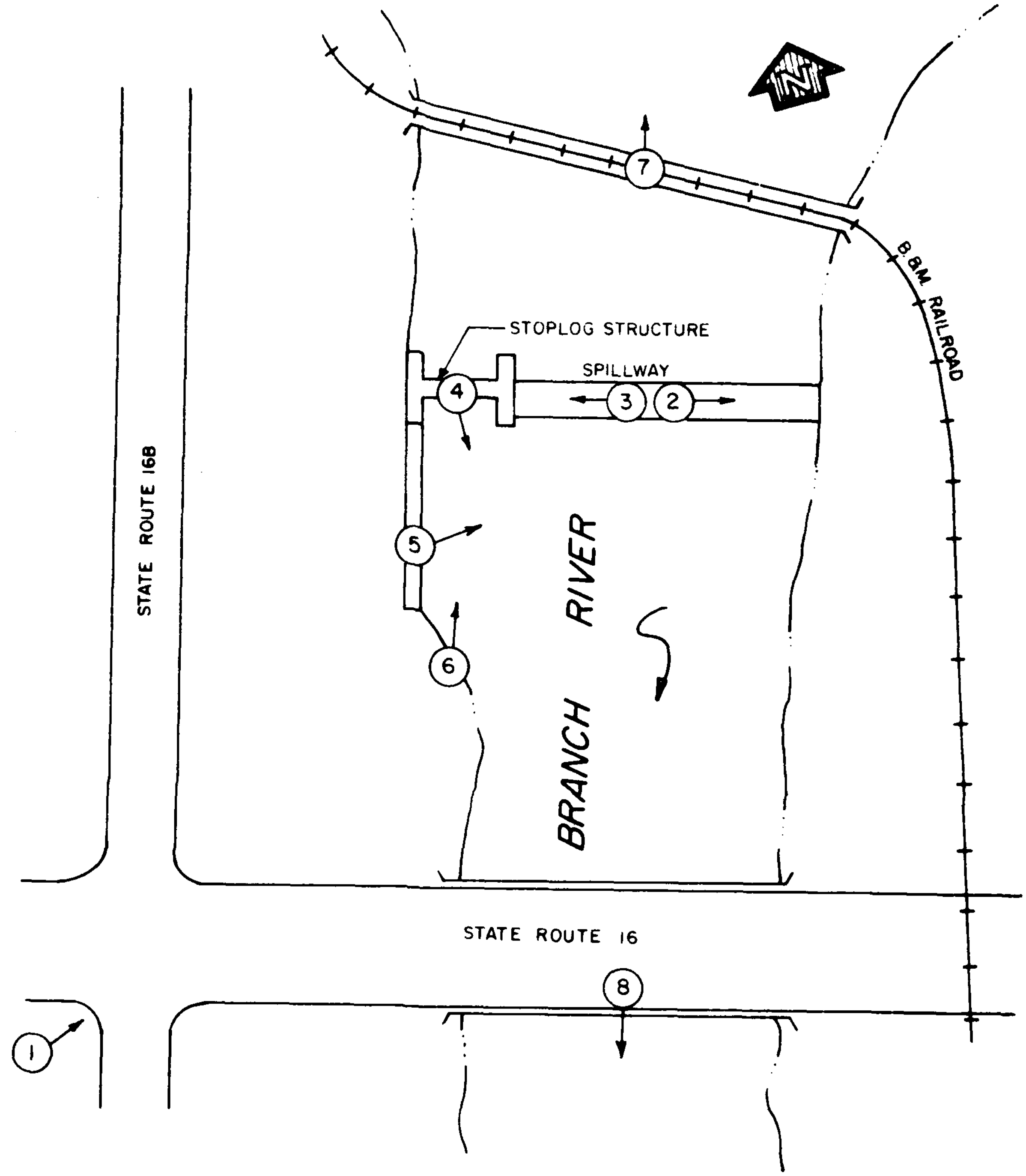
BRANCH RIVER — NEW HAMPSPSHIRE

SCALE NOT TO SCALE

DATE NOVEMBER 1979

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

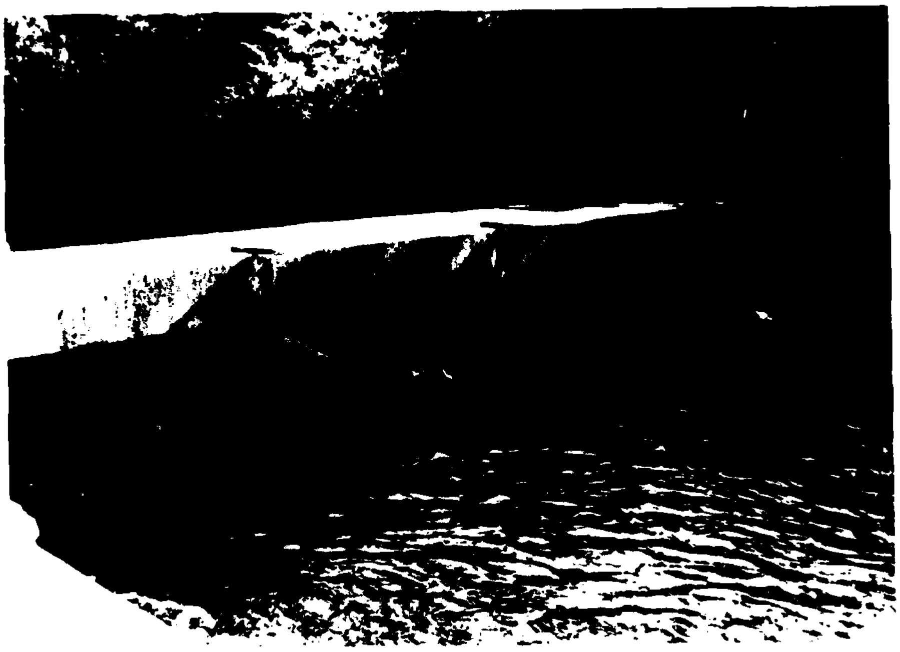
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

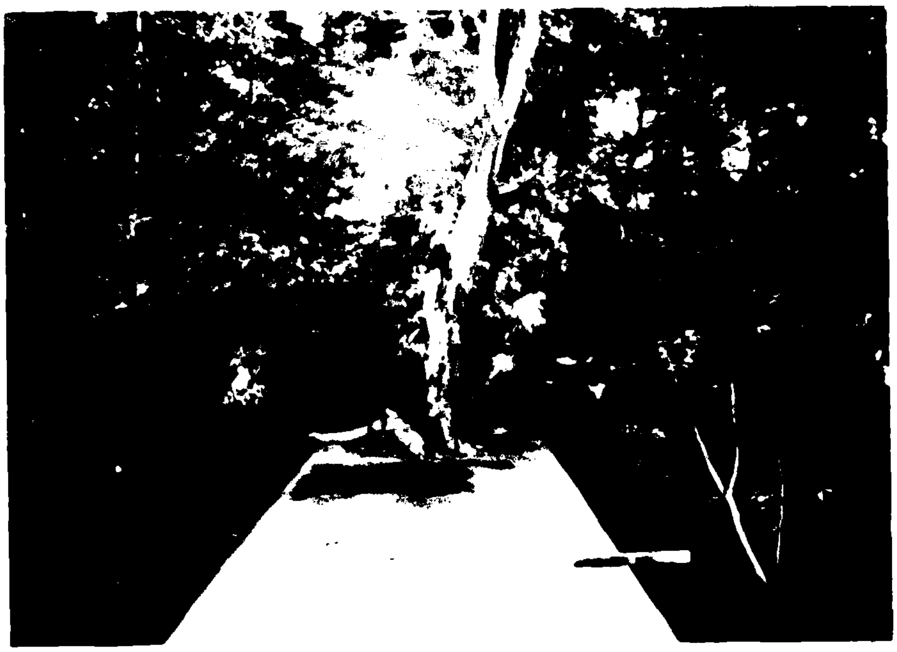
BRANCH RIVER — NEW HAMPSHIRE

SCALE NOT TO SCALE

DATE NOVEMBER 1979



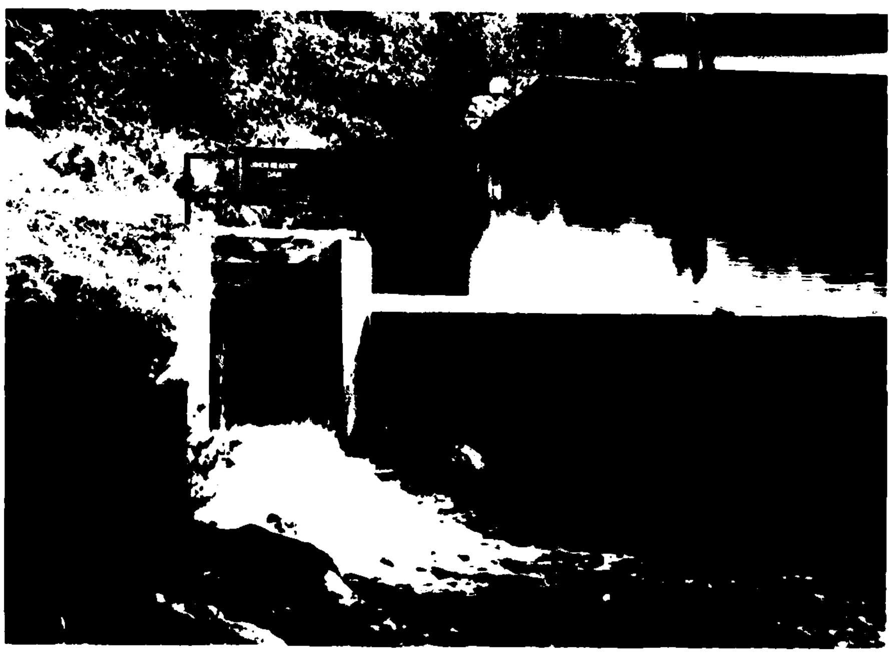
September 19, 1979
Figure 3 - Looking northeast at downstream face of dam.



September 19, 1979
Figure 4 - Looking east along principal spillway crest. Note steep, soil covered bedrock east abutment at end of spillway.

September 19, 1979

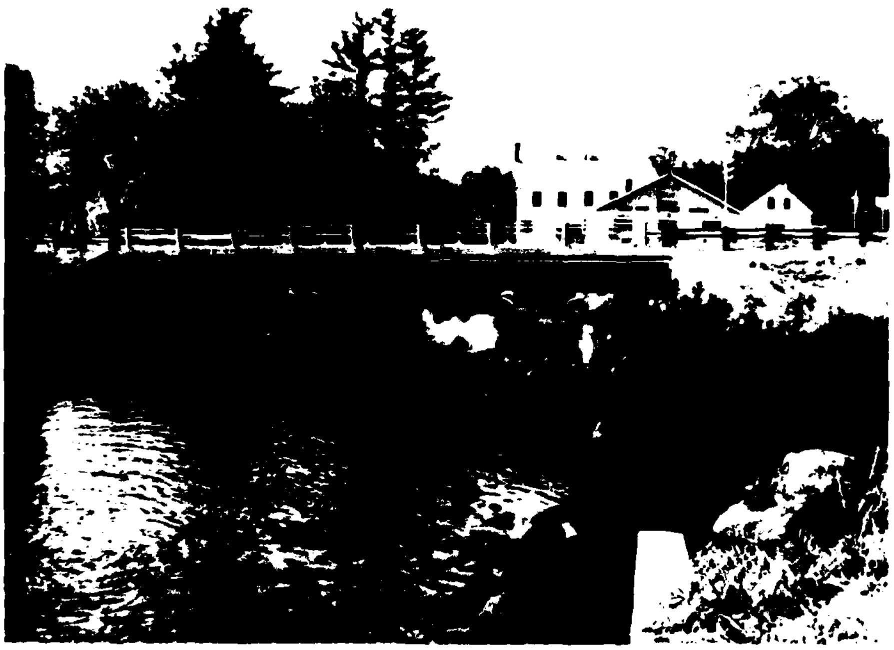
Figure 5 - Looking west along principal spillway crest. Note concrete training wall just downstream of stoplog structure.



September 19, 1979

Figure 6 - Looking north at downstream face of stoplog structure.

September 19, 1979
Figure 7 - Looking north at upstream reservoir from top of B&M Railroad bridge.

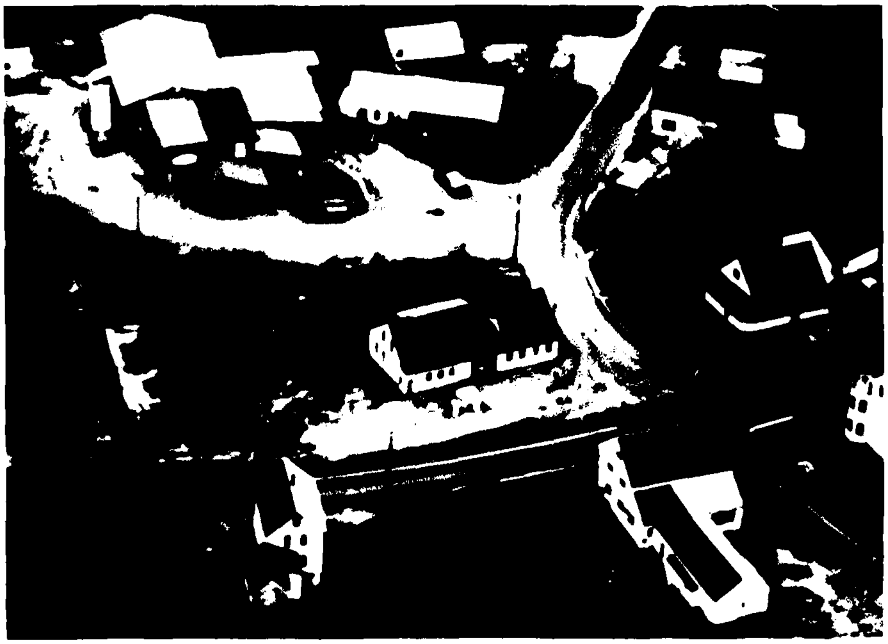


September 19, 1979
Figure 8 - Looking south at State Route 16 bridge from top of stoplog structure.

September 19, 1979
Figure 9 - Looking south at Reach 2 from Route 16 bridge.

September 19, 1979
Figure 10 - Looking northwest at Reach 2 just upstream of Dam "A".

September 19, 1979
Figure 11 - Looking northwest at downstream face of Dam "A".



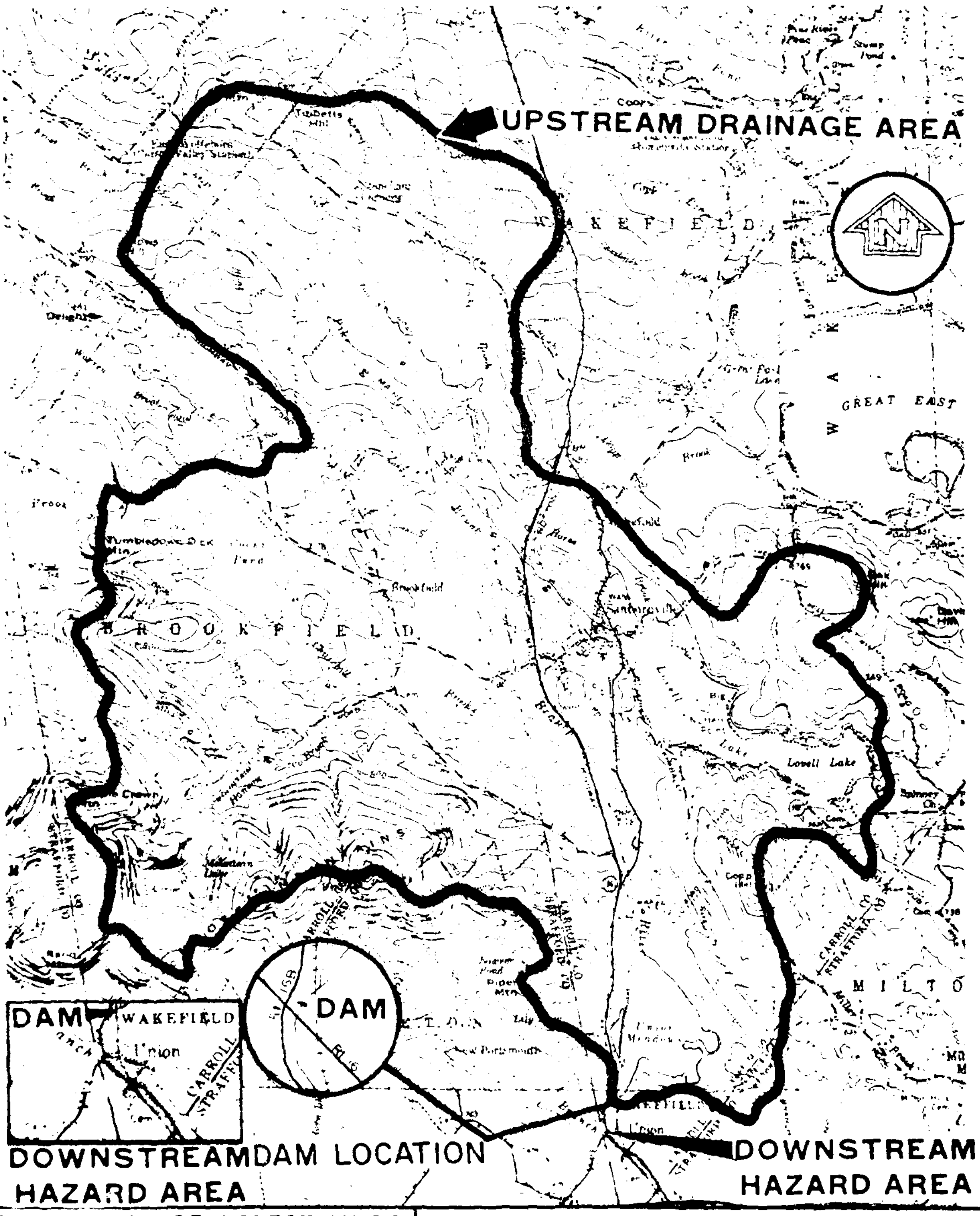
September 19, 1979
Figure 12 - Overview looking east at Dam "A". Note Maple Street bridge just downstream.

September 19, 1979
Figure 13 - Looking south at Reach 3 downstream of Dam "A".

September 19, 1979
Figure 14 - Looking southeast at Reach 4 downstream of Maple Street.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

UNION MEADOWS DAM

WAKEFIELD, NEW HAMPSHIRE

REGIONAL VICINITY MAP

NOVEMBER 1979

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

0 1/2 1 2 3 4

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEETS. WOLFEBORO, N.H. 1958. NEWFIELD, N.H.-ME. 1958. ALTON, N.H. 1952. BERWICK, ME.-N.H. 1958.

WPS
31 Oct
Rev. 6 Nov

HYDROLOGY & HYDRAULICS

Union Meadows Dam

Drainage area ≐ 31.1 mi²
Size Classification : Intermediate
Hazard Classification : Significant
Test Flood = 1/2 PMF

Calculate the PMF using "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, March, 1978."

Average slope of drainage area ≈ 70 ft/mile ; therefore, the "rolling" curve will be used to obtain a CSM value:

26.1 mi² (1370 CSM) = 35,757 cfs

Add routed outflow from Lovell Lake* of 3050 cfs

PMF = 35,757 + 3050 = 38,807 say 38,800 cfs

1/2 PMF = 38,800 ÷ 2 = **19,400 cfs**

Determine surcharge height to pass Q_p of 19,400 cfs, the test flood inflow. To obtain this, a discharge rating must be generated for Union Meadows dam. Outflow would occur first through the stoplog structure, then over the spillway crest (when stoplogs are not in place). Higher flood waters would inundate part of the dirt road that acts as an emergency spillway at the southeast side of Union Meadows (see sketch, App. B).

In trial ①, assume that stoplogs have been removed;
In trial ②, assume stoplogs are in place.

* See p. D-4, Lovell Lake Dam, Phase I Inspection Report, August, 1978. Lovell Lake drainage area ≐ 5 mi²

Develop a rating curve at Union Meadows...

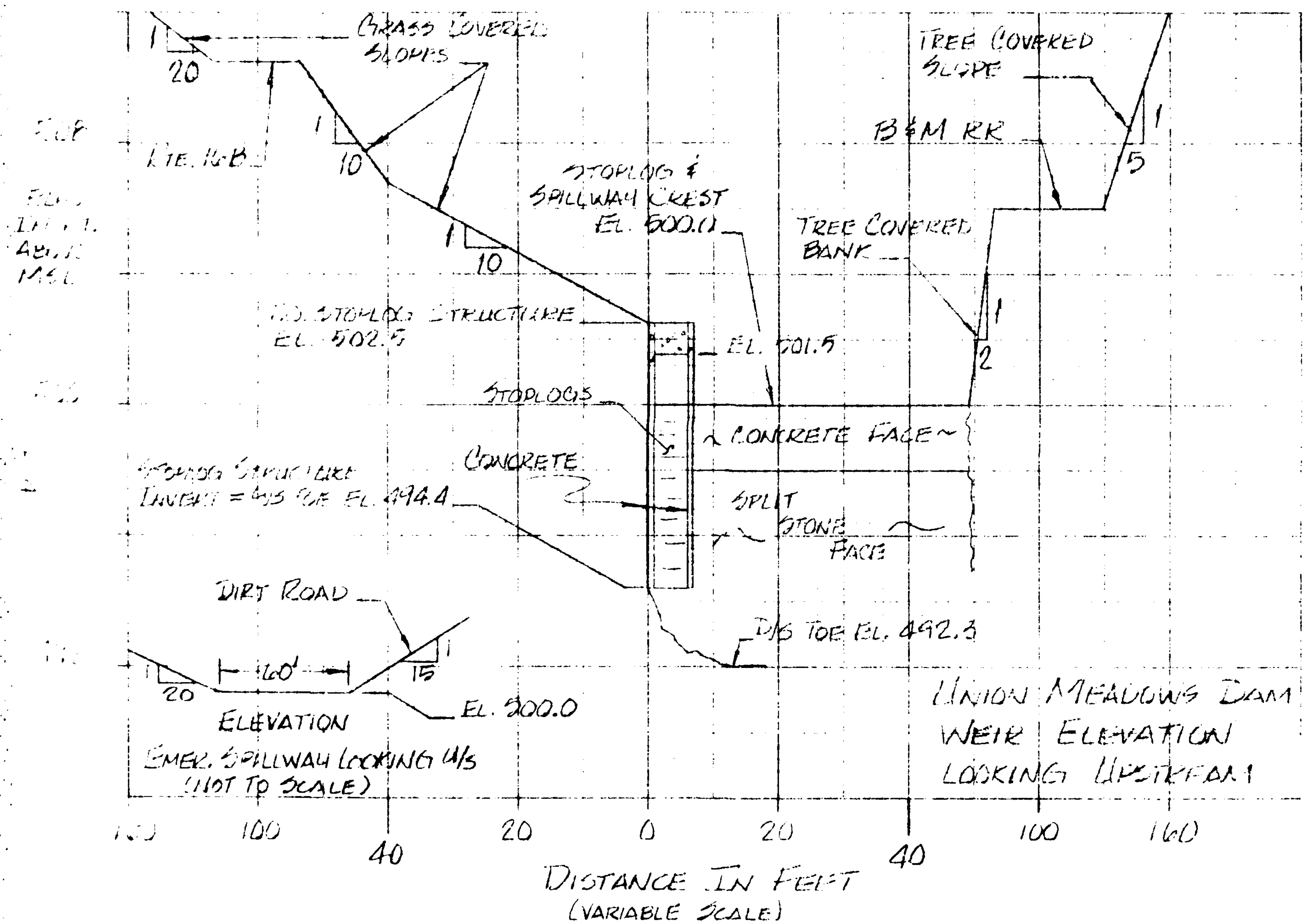
① Assume: Seepage rate can be neglected.
(Obstruction to flow due to presence of concrete slab (top of stoplog structure) is negligible.

Use weir equation to estimate flow over dam, emergency spillway, and natural ground abutments...

$Q = CLH^{3/2}$

Weir coefficients, C, must be estimated. Using the Brater & King Handbook of Hydraulics, the following weir coefficients were obtained from table 5-3, p. 5-40...

Nat. ground west of RR ...	2.6
Route 10E ...	2.7
West abutment ...	2.6
Sill of stoplog structure ...	2.7
Stoplog crest ...	3.3
Top of stoplog structure ...	2.5
Principal spillway crest ...	2.7
East abutment ...	2.5
B&M RR bed ...	2.6
Nat. ground east of RR ...	2.5
Dirt road emergency spillway ...	2.5


GRASS COVERED SLOPES
TIE. 16B
STOPLOG & SPILLWAY CREST EL. 500.0
U.S. STOPLOG STRUCTURE EL. 502.5
EL. 501.5
STOPLOGS
CONCRETE
CONCRETE FACE
SPLIT STONE FACE
TREE COVERED SLOPE
B&M RR
TREE COVERED BANK
D/S TOE EL. 492.3
DIRT ROAD
160'
EL. 500.0
ELEVATION
EMER. SPILLWAY LOOKING U/S
(NOT TO SCALE)
UNION MEADOWS DAM
WEIR ELEVATION
LOOKING UPSTREAM
DISTANCE IN FEET
(VARIABLE SCALE)

21 Oct 79
[illegible] Nov 79

Trial ① – Assume [illegible]

The following [illegible] shown on [illegible] D-4.

Stage*	Elevation▽	[illegible]
2	496.4	$Q = 2.7([illegible])(2)^{3/2} = [illegible]$ cfs
4	498.4	$Q = 2.7([illegible])(4)^{3/2} = 105$ cfs
6	500.4	$Q = 2.7([illegible])^{3/2} + 2.7(60)(0.4)^{3/2} + 2.5(1/2)(2)(0.4)(0.4)^{3/2} + 2.5(60)(0.4)^{3/2} + 2.5(1/2)(15)(0.4)(0.4)^{3/2} + 2.5(1/2)(20)(0.4)(0.4)^{3/2} = 282$ cfs

8 502.4 ... Above elevation 501.5, [illegible] flow would occur through the [illegible] structure.

Calculate [illegible] the orifice equation ... $Q = Ca\sqrt{2gh}$

$$^{①}C = \left(1 + 0.4r^{0.3} + \frac{0.0045L}{r^{1.25}}\right)^{-1/2} \qquad r = \frac{A}{P} = \frac{[illegible]}{[illegible]} = 1.47'$$

$$C = \left(1 + 0.4(1.47)^{0.3} + \frac{0.0045([illegible])}{(1.47)^{1.25}}\right)^{-1/2} = 0.[illegible]$$

... take "h" [illegible] ℄ of [illegible], [illegible] 497.9[illegible].

---

8 502.4 $Q = 0.[illegible]([illegible])\sqrt{[illegible]} + 2.7([illegible])(2.4)^{3/2} + 2.5([illegible])(2.4)^{3/2} + 2.5([illegible])(2.4)^{3/2} + 2.5([illegible])(2.4)([illegible])^{3/2} + 2.5(1/2)(20)(2.4)(2.4)^{3/2} = 2,066$ cfs

① Equation 4-[illegible] [illegible] 4-24, [illegible]
[illegible]
* Stage [illegible]
▽ Elevation [illegible]

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Stage*	Elevation▽	Discharge
10	504.4	$Q = 2.6(1/2)([illegible])([illegible])([illegible])^{3/2} + 0.82(35.5)\sqrt{2g(6.45)}$ $+ 2.5(7)([illegible])^{3/2} + 2.7(60)(4.4)^{3/2}$ $+ 2.5(1/2)(5)(4.4)(4.4)^{3/2} + 2.5(60)(4.4)^{3/2}$ $+ 2.5(1/2)(15)(4.4)(4.4)^{3/2} + 2.5(1/2)(20)(4.4)(4.4)^{3/2} = 5{,}566$ cfs
12	506.4	$Q = 2.6(1/2)([illegible])(3.9)(3.9)^{3/2} + 0.82(35.5)\sqrt{2g(5.45)}$ $+ 2.8(7)(3.9)^{3/2} + 2.7(60)(6.4)^{3/2}$ $+ 2.5(1/2)(2)(6.0)(6.0)^{3/2} + 2.5(12)(0.4)^{3/2}$ $+ 2.6(50)(0.4)^{3/2} + 2.5(1/2)(5)(0.4)(0.4)^{3/2}$ $+ 2.5(60)(6.4)^{3/2} + 2.5(1/2)(15)(6.4)(6.4)^{3/2}$ $+ 2.5(1/2)(20)(6.4)(6.4)^{3/2} = 11{,}067$ cfs
15	509.4	$Q = 2.6(1/2)([illegible])(6.9)(6.9)^{3/2} + 0.82(35.5)\sqrt{2g(11.45)}$ $+ 2.5(7)(6.9)^{3/2} + 2.7(60)(9.4)^{3/2}$ $+ 2.5(1/2)(2)(9.0)(9.0)^{3/2} + 2.5(12)(3.4)^{3/2}$ $+ 2.6(50)(3.4)^{3/2} + 2.5(1/2)(5)(3.4)(3.4)^{3/2}$ $+ 2.5(60)(9.4)^{3/2} + 2.5(1/2)(15)(9.4)(9.4)^{3/2}$ $+ 2.5(1/2)(20)(9.4)(9.4)^{3/2} = 24{,}972$ cfs

Use the above data [for] the rating curve shown on p. D-9.

* Stage in feet above spillway sill.
▽ Elevation in feet above MSL.

[illegible]
[illegible]
[illegible]

Trial ② - Assume [illegible]

The [illegible]
p. L-4.

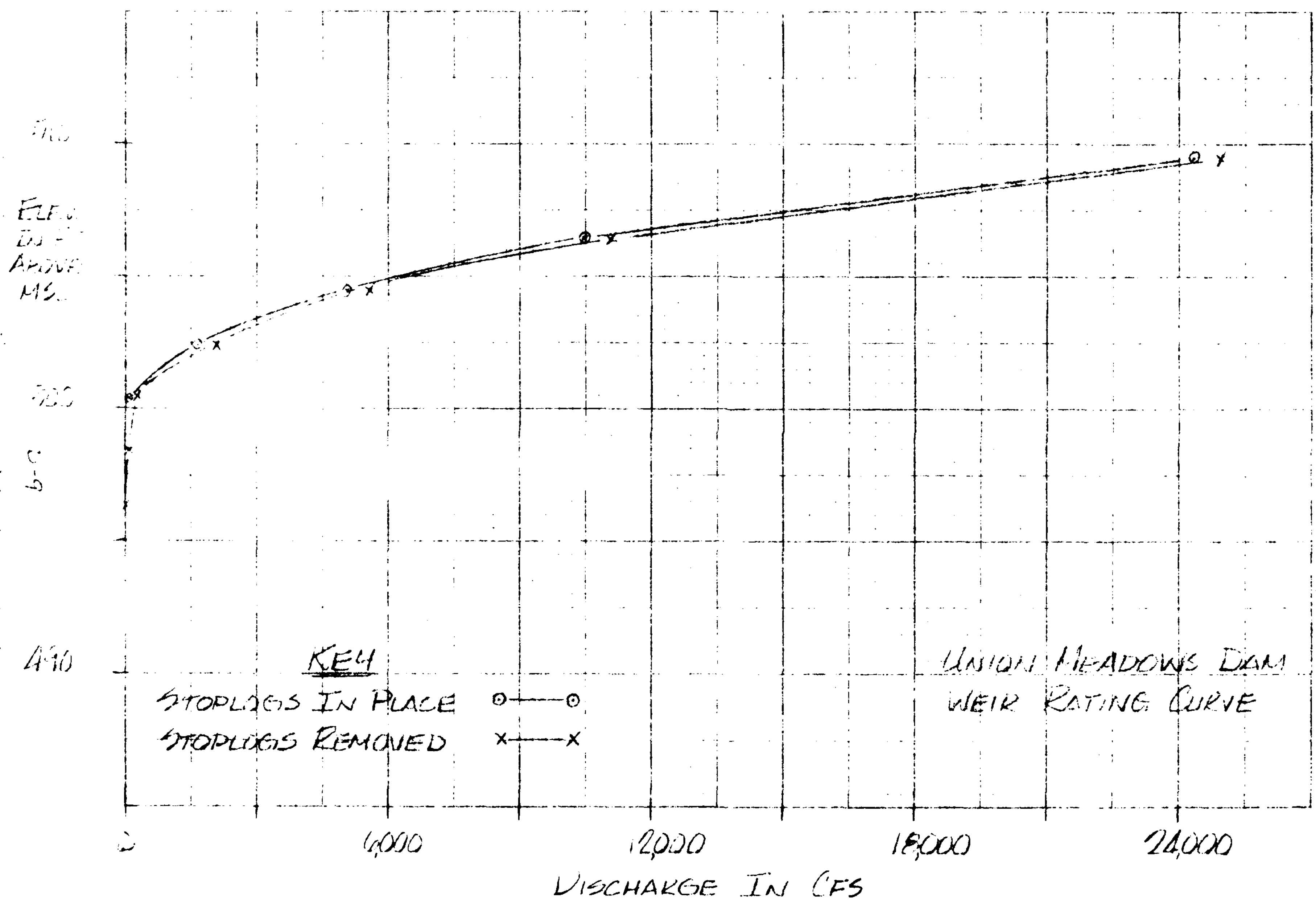
Stage*	Elevation▽	[illegible]
2	496.4	0
4	498.4	0
6	500.4	$Q = 2.7(5)(0.4)^{3/2} + [illegible](0.4)^{3/2} + 2.5(1/2)(2)(0.4)(0.4)^{3/2} + 2.5(20)(0.4)^{3/2} + 2.5(1/2)(5)(0.4)(0.4)^{3/2} + 2.5(1/2)[illegible](0.4)(0.4)^{3/2} = 87$ cfs
8	[illegible]	$Q = 0.52[illegible]\sqrt{2g[illegible]} + 2.7(20)(2.4)^{3/2} + 2.5[illegible](2.4)^{3/2} + 2.5(20)(2.4)^{3/2} + [illegible](2.4)(2.4)^{3/2} + 2.5(1/2)(20)(2.4)(2.4)^{3/2} = 1636$ cfs
10	504.4	$Q = 0.52[illegible]\sqrt{2g(3.[illegible])} + [illegible](4.4)^{3/2} + [illegible](4.4)^{3/2} + 2.5[illegible](4.4)^{3/2} + [illegible](4.4)(4.4)^{3/2} + [illegible](1/2)(20)(4.4)(4.4)^{3/2} + [illegible](0.9)^{3/2} = 5007$ cfs
12	[illegible]	$Q = [illegible](0.[illegible])[illegible]^{3/2} + 0.52(75)\sqrt{2g[illegible]} + [illegible](3.7)^{3/2} + 2.7[illegible](6.4)^{3/2} + [illegible]^{3/2} + 2.5[illegible](6.4)^{3/2} + [illegible]^{3/2} + 2.5[illegible](6.4)(6.4)^{3/2} + [illegible](6.4)^{3/2} + [illegible](6.4)(6.4)^{3/2} = 10{,}505$ cfs

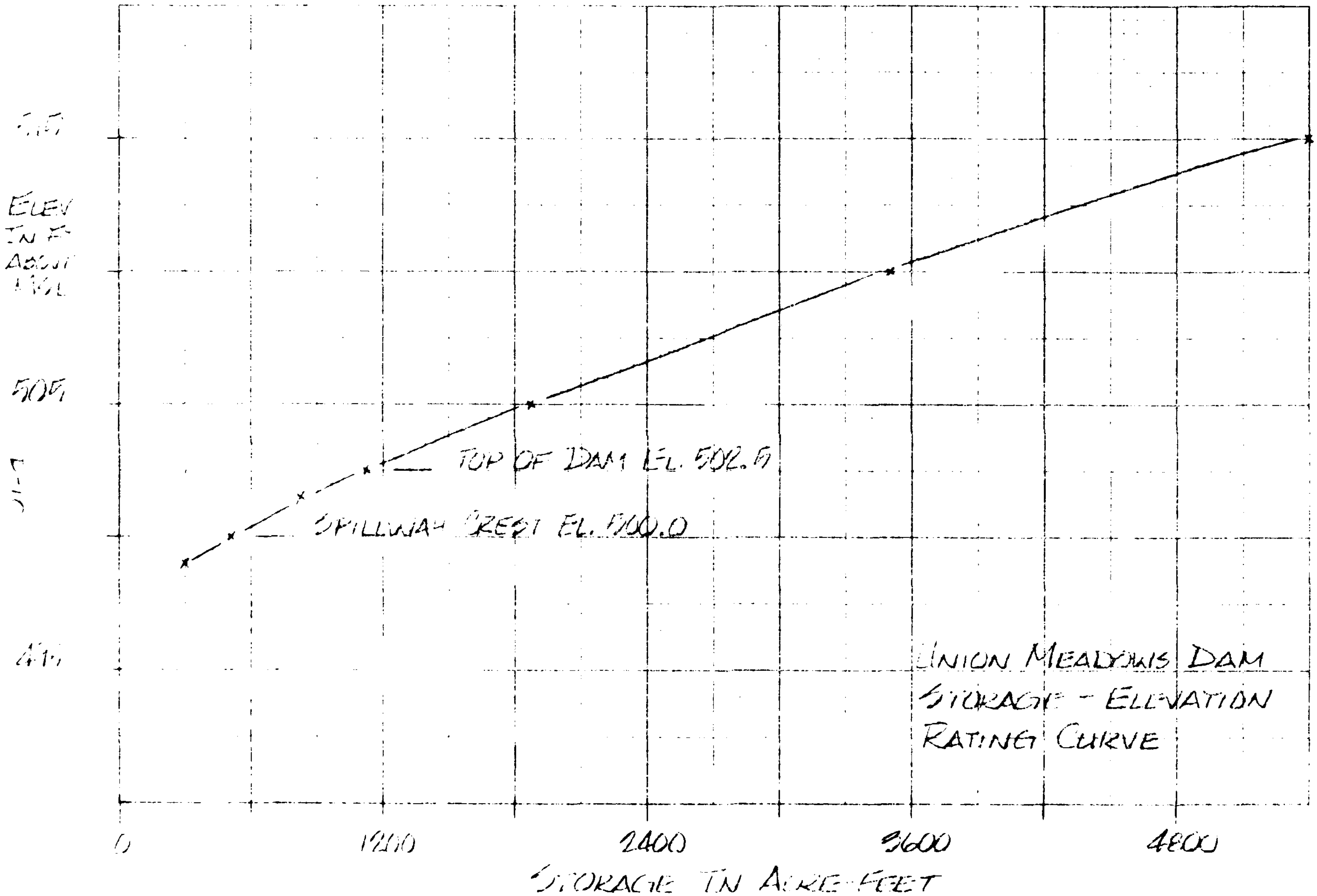
* [illegible]
▽ Elevation [illegible]

Stage[†]	Elevation[‡]	[illegible]
15	50 1.4	[illegible] + 257 [illegible] $(3.4)^{3/2}$ + [illegible] $(3.4)^{3/2}$ + 3.0 [illegible] $(3.4)^2$ + [illegible] $(3.4)(3.4)^{3/2}$ + [illegible] 6 [illegible] $(7.4)^{3/2}$ [illegible] = 24,327 cfs

Use [illegible] to [illegible] curve [illegible].

† Stage in feet above [illegible] datum.
‡ Elevation in feet above MSL.


KEY
STOPLOGS IN PLACE
STOPLOGS REMOVED
UNION MEADOWS DAM
WEIR RATING CURVE
0
6,000
12,000
18,000
24,000
DISCHARGE IN CFS
490



ELEV IN FT ABOVE MSL
505
TOP OF DAM EL. 502.6
SPILLWAY CREST EL. 500.0
0
1200
2400
3600
4800
STORAGE IN ACRE-FEET
UNION MEADOWS DAM
STORAGE - ELEVATION
RATING CURVE

[illegible]
[illegible] 19
[illegible] 19

STORAGE ROUTING

Test flood = [illegible] PMF = [illegible] cfs, stage = 508.1 *

Normal [illegible] stage [illegible], storage = [illegible] ▽
[illegible] = 210 [illegible]

Q_{P1} = 19,400 cfs, stage = [illegible]8.4, storage = 2,970▽ ac ft

2970 − 510 = 2,460 ac ft

$2460 \text{ ac ft} \cdot \frac{1}{31.7 \text{ mi}^2} \cdot \frac{1 \text{ mi}^2}{640 \text{ ac}} \cdot \frac{12 \text{ in}}{\text{ft}} = 1.49$ in. runoff = STOR 1

$Q_{P2} = Q_{P1}\left(1 - \frac{STOR1}{9.5}\right) = 19{,}400\left(1 - \frac{1.49}{9.5}\right) = 16{,}357$ cfs

@ 16,357 cfs, stage = 507.7 *, storage = 2,700▽ ac ft

2,700 − 510 = 2,190 ac ft

$2190 \text{ ac ft} \cdot \frac{1}{31.7 \text{ mi}^2} \cdot \frac{\text{mi}^2}{640 \text{ ac}} \cdot \frac{12 \text{ in}}{\text{ft}} = 1.32$ in runoff = STOR 2

Avg. STOR = 1.49 + 1.32/2 = 1.41 in. or 0.115 ft runoff

$0.116 \text{ ft} \cdot \frac{31.7 \text{ mi}^2}{1} \cdot \frac{640 \text{ ac}}{\text{mi}^2} = 2{,}349$ ac ft

2349 + 510 = 2,859 ac ft

[illegible]
[illegible]

[illegible]
[illegible] 6 Nov 79

[illegible] 28,[illegible] [illegible] = [illegible] , [illegible] = [illegible] *

[illegible] = 18,000 [illegible], [illegible]

Inflow - Outflow = 9,[illegible] = [illegible]

[illegible]

Test [illegible] = 15,000 [illegible]

Test [illegible] = 508.[illegible]

Top of dam elevation = [illegible] 2[illegible]

[illegible] dam [illegible] 508.[illegible] [illegible]
during [illegible]

[illegible]
[illegible]

[illegible]

[illegible]
1 Nov 79

BREACH ANALYSIS - [illegible] DAM

Purpose: Determine degree of downstream [illegible].

Assume: [illegible] water [illegible] of maximum
[illegible] = 502.5
Upstream [illegible] elevation = 494.4

$Q_{P1} = 8/27\ W_b \sqrt{g}\ Y_o^{3/2}$

where W_b = [illegible]
g = 32.2 ft/sec²
Y_o = pool elev. - [illegible] elev.

@ Union [illegible]

W_b = 60 feet*
Y_o = 502.5 - 494.4 = 8.1 feet

$Q_{P1} = 8/27\ (60)\sqrt{g}\ (8.1)^{3/2}$ = 23[illegible]

Antecedent discharge = Orifice flow [illegible] stoplog opening
+ weir flow over principal [illegible]
+ [illegible]

Ant. $Q = CA\sqrt{2gh} + [illegible]^{3/2} + [illegible]^{3/2}$

Orifice coeff. $C^{\nabla} = (1 + 0.4 r^{0.3} + \frac{0.0045}{r^{1.25}})^{-2}$, [illegible] = 0.55

$C = (1 + 0.4(0.55)^{0.3} + \frac{0.0045(3)}{(0.55)^{1.25}})^{-2}$ = 0.56

* [illegible]
[illegible]

$^{\nabla}$ Equation 4-[illegible], p. 4-[illegible] [illegible]
Hydraulics.

11/[illegible]
1 Nov 79

[illegible] ANALYSIS CONT.

[illegible]

[illegible]

[illegible]

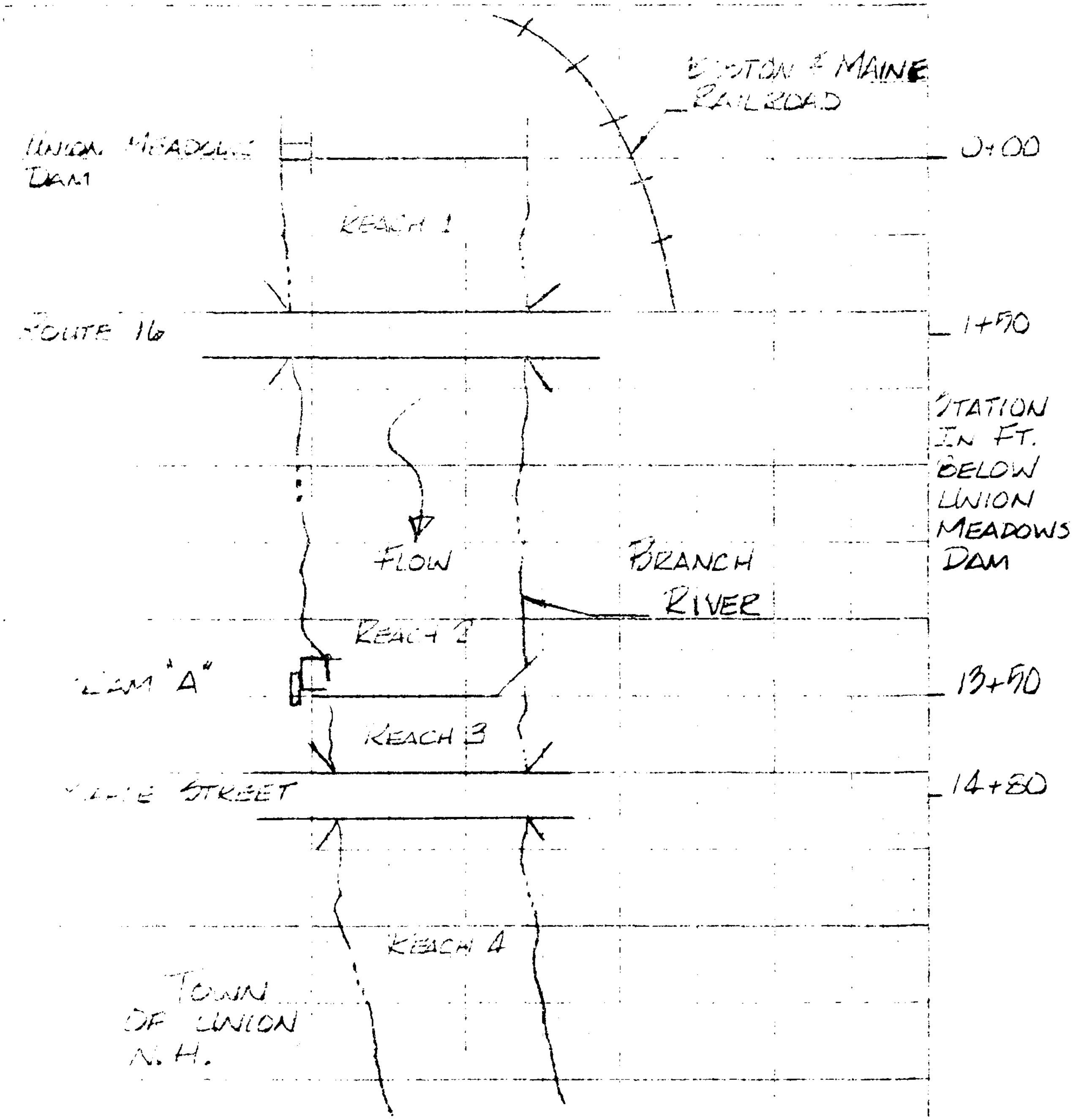
Analyze Reach 1 as shown on p. D-15.

Use the Manning Equation to calculate flow through the cross section on p. D-16.

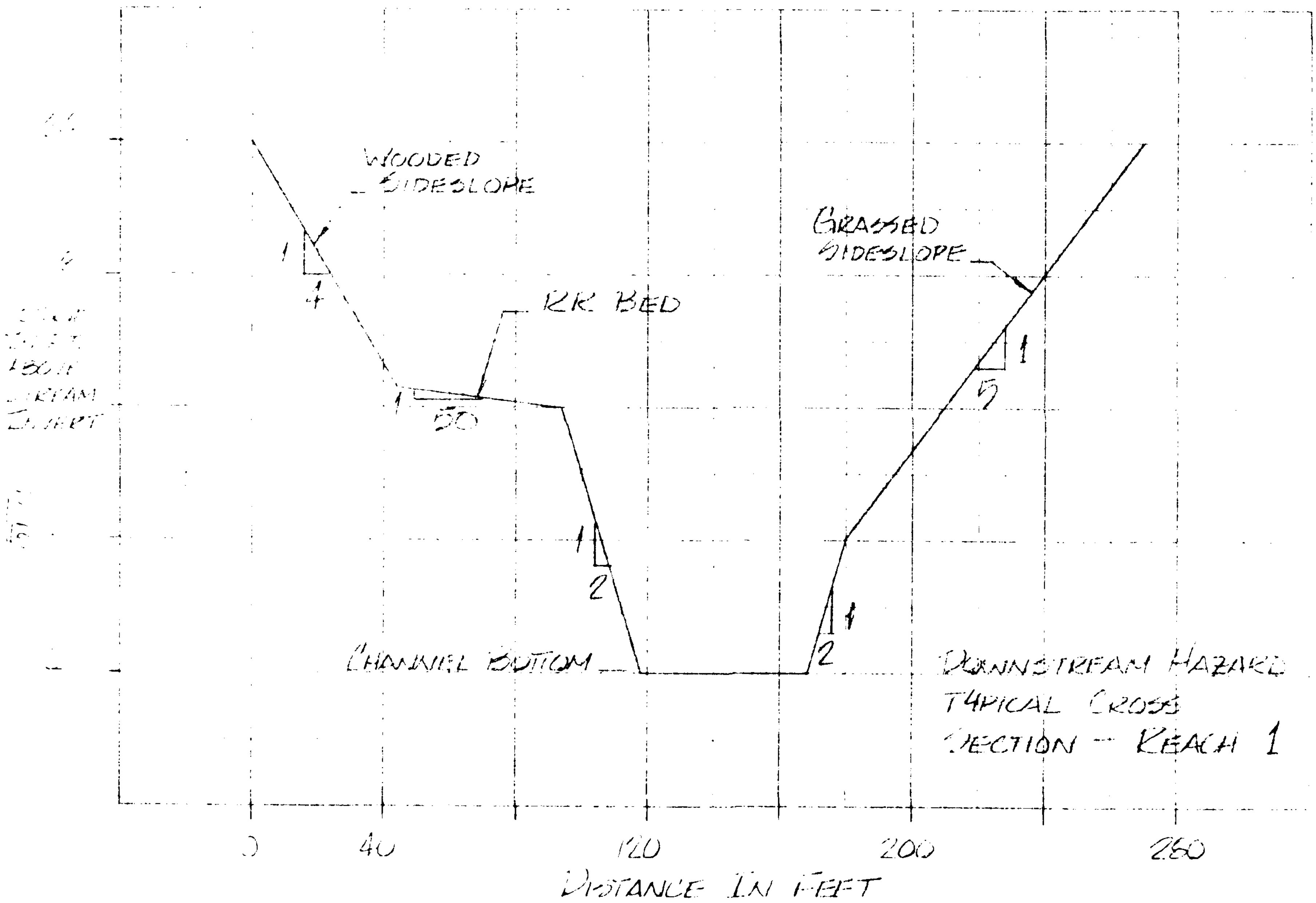
$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where $n \equiv$ channel roughness coefficient
$A \equiv$ area of cross section
$R \equiv$ hydraulic radius $= A$/wetted perimeter
$S \equiv$ slope of reach

length of reach = 150 feet
downstream dam toe elevation = 492.3
stream invert elevation @ Ste Rte. 16 = 491.3
slope of reach = 0.007
"n" varies from 0.05 to 0.09



PLAN OF DOWNSTREAM HAZARD REACH



DOWNSTREAM HAZARD TYPICAL CROSS SECTION - REACH 1

1 Nov 74

BREACH ANALYSIS [illegible]

The following [illegible] 10 ft [illegible] 200 [illegible] the open channel [illegible] using the data [illegible]

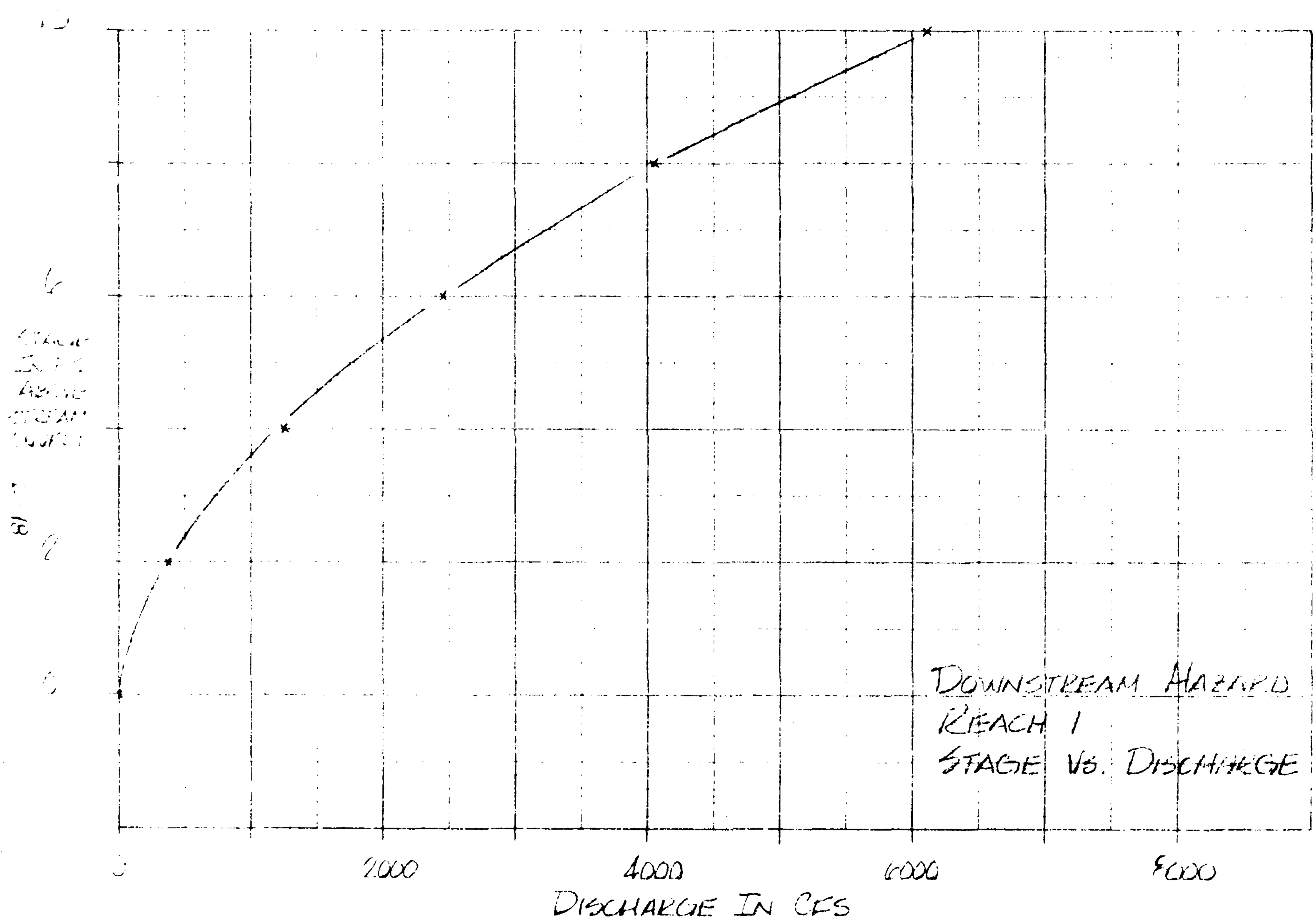
[illegible]	[illegible]	[illegible]	Q (cfs)
[illegible]	[illegible]	59.0	592
4	23[illegible]	61.9	1240
6	[illegible]	76.9	2260
8	[illegible].7	91.[illegible]	4037
10	124.0	10[illegible].1	6110

Use [illegible] the stage-discharge [illegible] Referring to the curve;

① Q_A [illegible] = 143 cfs, stage = 3.0 feet

② Q_B (Total breach Q) = 2426 cfs, stage = 5.9 feet

[illegible] + 3.0 = 3.9 feet would result. No [illegible] likely to occur.



DOWNSTREAM HAZARD
REACH 1
STAGE VS. DISCHARGE
DISCHARGE IN CFS
0
2000
4000
6000
8000

11 Nov 79

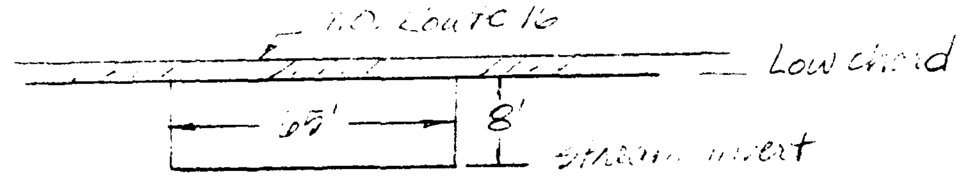
BREACH ANALYSIS (CONT'D)

Analyze flow [illegible] to bridge [illegible]

Use the Manning equation [illegible] that can [illegible] 8 [illegible] stream invert.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

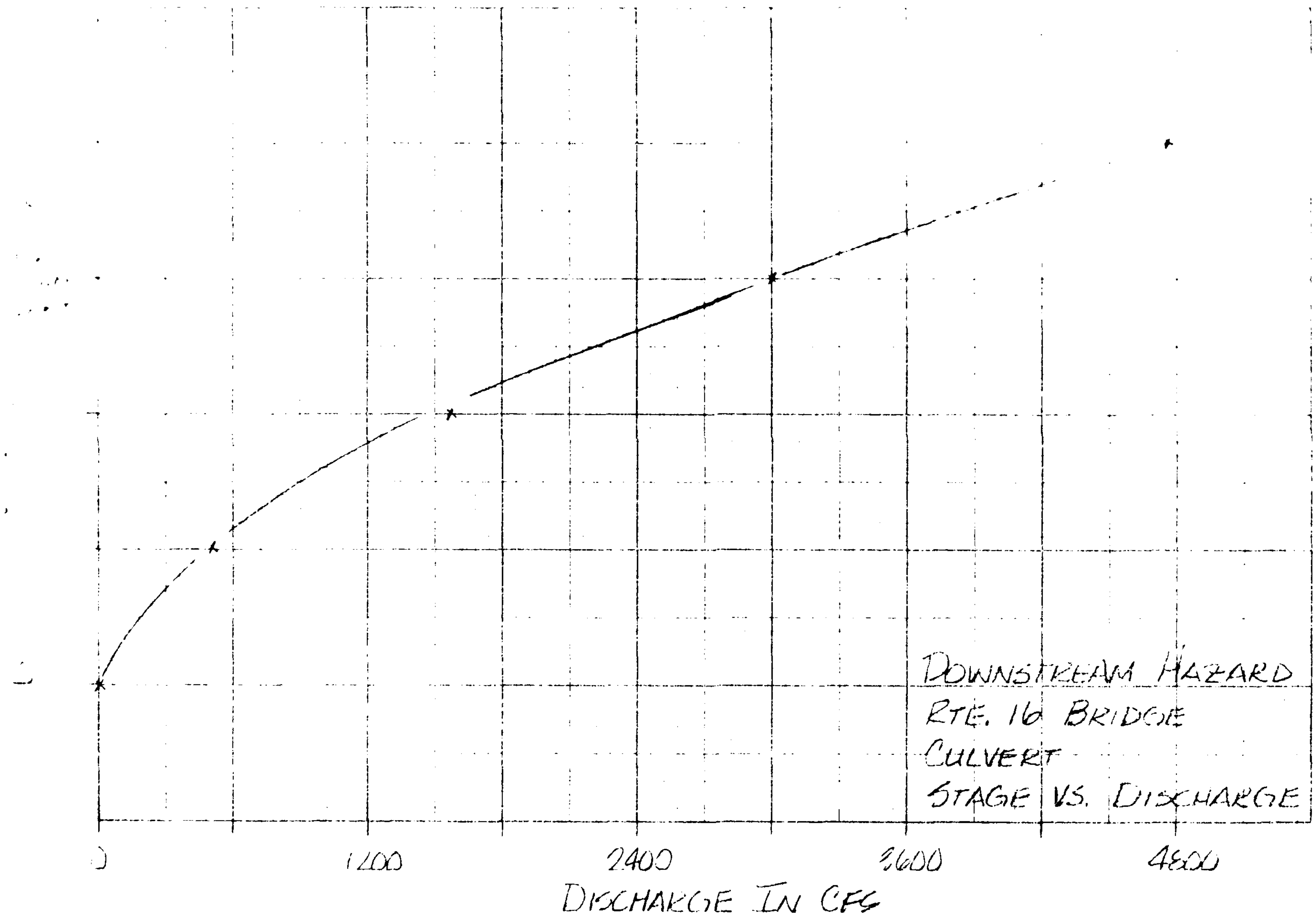
where n of Manning = 0.07 (see p. D-14)
n varies from 0.07 to 0.05.



The following table was generated using a Commodore Pet 2001 desk computer. Manning's Equation for open channel flow was programmed into the computer using the above data.

Stage [illegible] above stream invert	X-sect. area (ft^2)	Wetted perimeter	Q (cfs)
[illegible]	[illegible].6	69.1	512
[illegible]	[illegible].6	73.1	1571
[illegible]	[illegible].6	77.1	3010
[illegible]	[illegible].6	81.1	47[illegible]

[illegible] bridge [illegible]


DOWNSTREAM HAZARD
RTE. 16 BRIDGE
CULVERT
STAGE VS. DISCHARGE
0
1200
2400
3600
4800
DISCHARGE IN CFS

[illegible] 79

BREACH ANALYSIS (CONT.)

Referring to [illegible] on p. L-20,

① Q_A = 74[illegible] c/s, stage ≐ [illegible].5 feet
② Q_B = 2428 c/s, stage ≐ 5.3 feet

An increase in stage due to breach of [illegible] = 1.8 feet would result. The bridge [illegible] carry the total breach flow at a stage of 5.3 feet. Damage is not likely here.

Analyze flow through Reach 2 as shown on p. L-15.

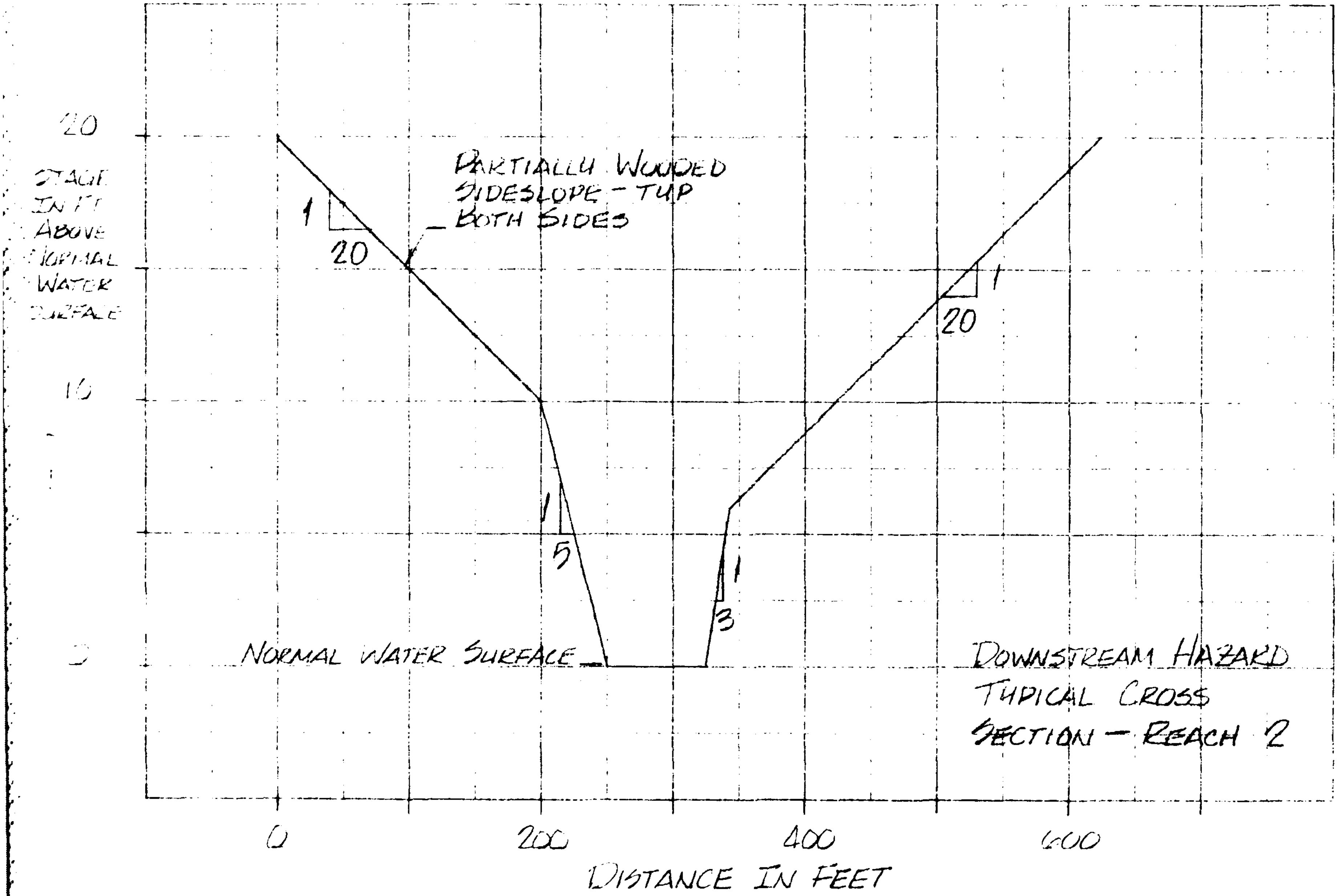
Use the Manning Equation, $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

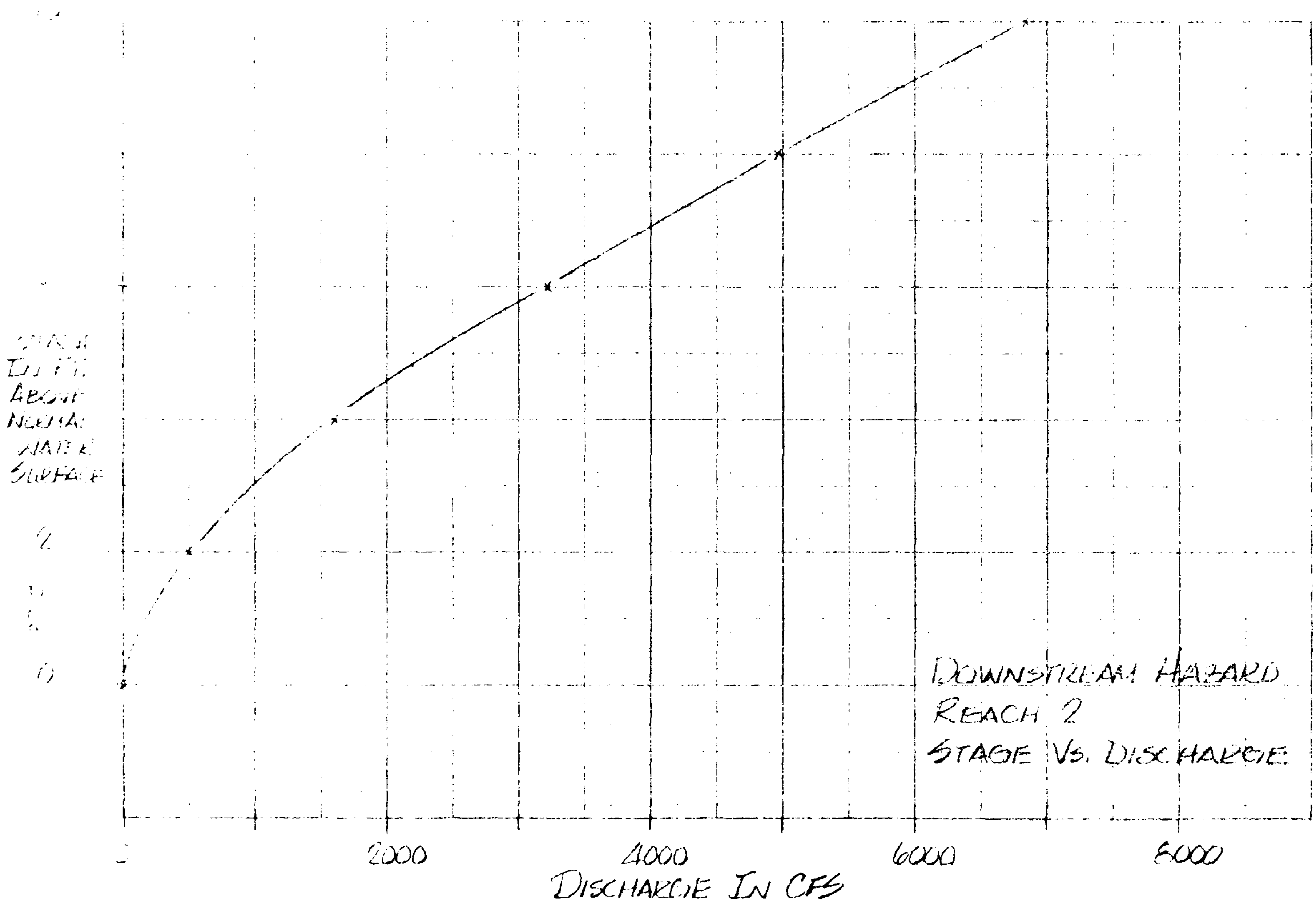
Length of reach = 200 feet
Slope of reach = 0.00[illegible]
"n" varies from 0.0[illegible] to 0.0[illegible]

The following [illegible] using the Compucorp [illegible] 200 [illegible]. Manning's Equation [illegible] programmed into the computer using the data on pp. L-21 & L-22.

Stage [illegible] normal water surface	X-sect [illegible]	Wetted perimeter	Q (c/s)
2	166.[illegible]	91.6	501
4	[illegible]	105.1	1004
[illegible]	[illegible].2	124.8	322[illegible]
8	[illegible]	[illegible]	4996
10	[illegible]	[illegible]4.[illegible]	6517

[illegible] stage discharge [illegible] L-23.


20
STAGE IN FT ABOVE NORMAL WATER SURFACE
10
0
PARTIALLY WOODED SIDESLOPE - TYP BOTH SIDES
1
20
1
5
1
3
1
20
NORMAL WATER SURFACE
DOWNSTREAM HAZARD TYPICAL CROSS SECTION - REACH 2
0
200
400
600
DISTANCE IN FEET


DOWNSTREAM HAZARD
REACH 2
STAGE Vs. DISCHARGE
ABOVE
NORMAL
WATER
SURFACE
2000
4000
6000
8000
DISCHARGE IN CFS

[illegible]
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BREACH ANALYSIS (cont.)

Referring to the [illegible] on p. L-23,

① Q_A = 742 [illegible], [illegible] = 5.5 [illegible]
③ Q_B = 24[illegible] [illegible], [illegible] = 5.2 feet

An [illegible] 5.2 - 2.5 = 2.7 feet [illegible]. Two [illegible] about 4 feet of water. [illegible] of [illegible] about 3 feet of water. Significant property damage would occur [illegible] is expected.

Analyze [illegible] Dam "A" [illegible] a weir causing a drop in [illegible] elevation.

Weir equation: $Q = C^{*}LH^{3/2}$

The [illegible] on p. L-26.

Change in [illegible] top [illegible]	[illegible]
4	[illegible] = [illegible]
6	[illegible] = 555 [illegible]
7	Q = [illegible] = [illegible] cfs

* "C" [illegible]

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BREACH ANALYSIS (Cont'd)

Stage in ft. above top of old gate	Q (cfs)
5	$Q = 2.5(4)(5)^{3/2} + 2.6(2)(3)(4)(4)^{3/2} + 2.5(30)(4)^{3/2} + 2.5(6)(4)^{3/2} + 2.5(9)(4)^{3/2} + 2.6(2)(25)(4)(4)^{3/2} = 3,374$ cfs
[illegible]	$Q = 2.5(4)(\ldots)^{3/2} + 2.6(\ldots)(3)(\ldots)(5)^{3/2} + 2.5(\ldots)(5)^{3/2} + 2.5(\ldots)(5)^{3/2} + 2.5(9)(5)^{3/2} + 2.6(\ldots)(\ldots)^{3/2} + 2.5(\ldots)(\ldots)(\ldots)^{3/2} + 2.7(\ldots)^{3/2} + 2.8(5)(\ldots)^{3/2} = 4,378$ cfs
[illegible]	$Q = 2.5(4)(\ldots)^{3/2} + 2.6(2)(3)(6)(6)^{3/2} + 2.5(30)(6)^{3/2} + 2.5(6)(6)^{3/2} + 2.5(9)(6)^{3/2} + 2.6(2)(25)(6)(6)^{3/2} + 2.5(12)(6)(2)(2)^{3/2} + 2.7(4)(2)^{3/2} + 2.5(5)(2)^{3/2} = 6,263$ cfs

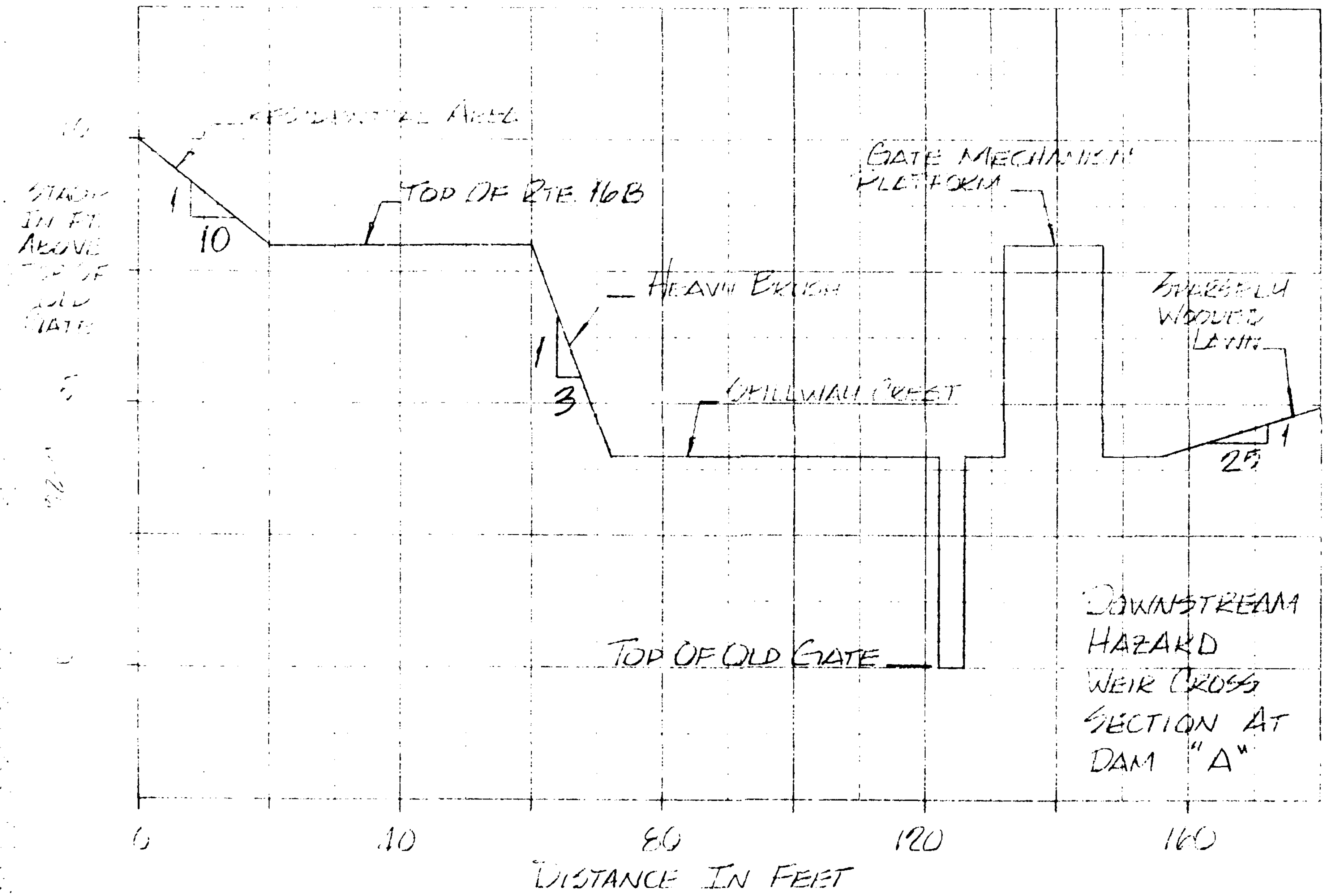
See [illegible] for [illegible] stage-discharge relationship on p. D-27.

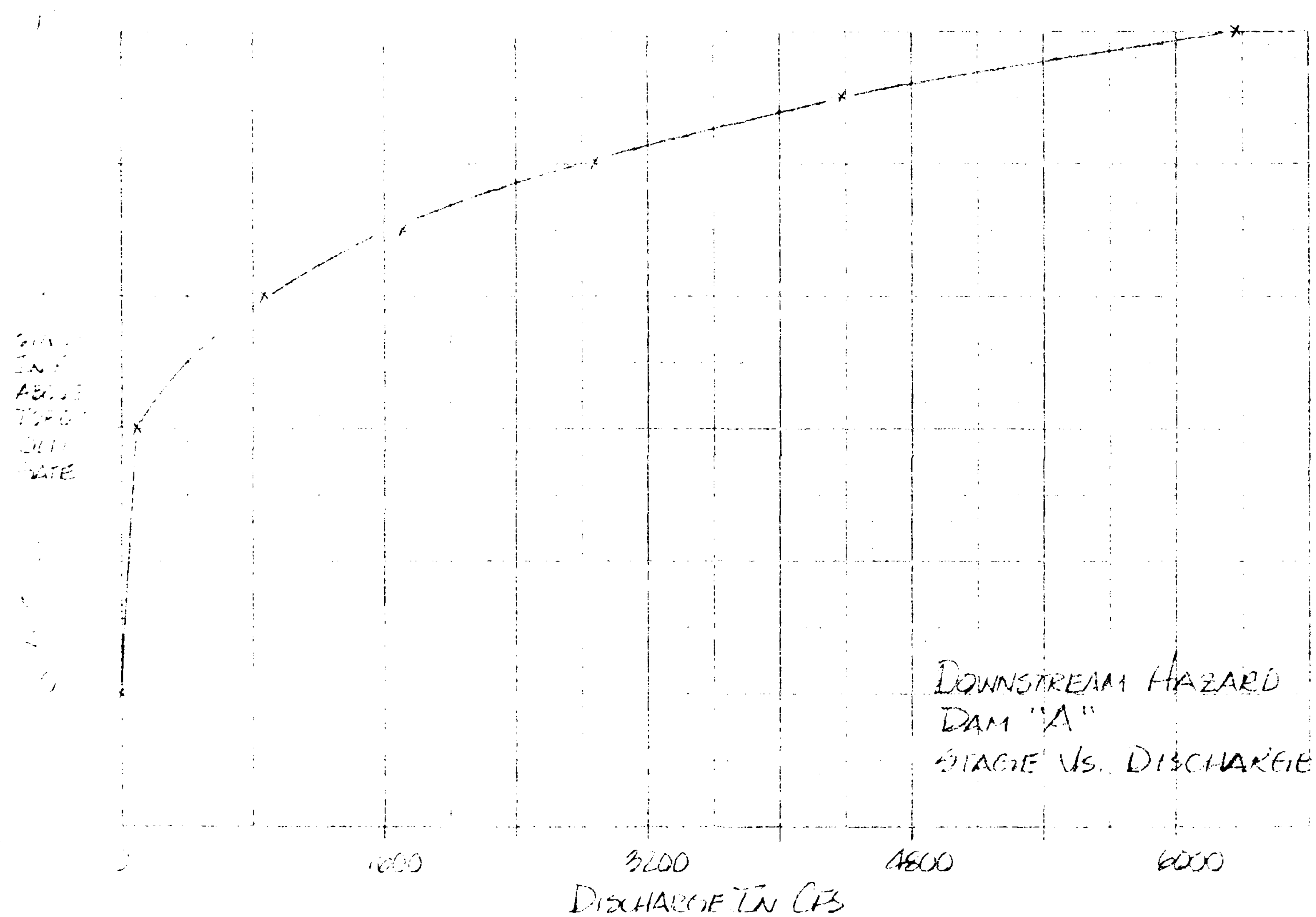
Referring to [illegible] rating curve on p. D-27,

Q_A = 725 cfs, stage = 5.6 feet
Q_B = 2425 cfs, stage = 7.6 feet

A[illegible] would [illegible] of 7.6 − 5.6 = 2.0 feet would result.

[illegible] 2 feet [illegible] data [illegible] damage [illegible] exceeded.


Residential Area
Top Of Rte. 16B
1
10
Heavy Brush
1
3
Spillway Crest
Gate Mechanism Platform
Extremely Wooded Land
1
25
Top Of Old Gate
Downstream Hazard Weir Cross Section At Dam "A"
Distance In Feet
0
40
80
120
160
10
5
0



0
1600
3200
4800
6000
DISCHARGE IN CFS
DOWNSTREAM HAZARD
DAM "A"
STAGE VS. DISCHARGE

BREACH ANALYSIS (CONT.)

[illegible]

[illegible]

Length of Main = 130 [illegible]
[illegible]
[illegible]

[illegible]

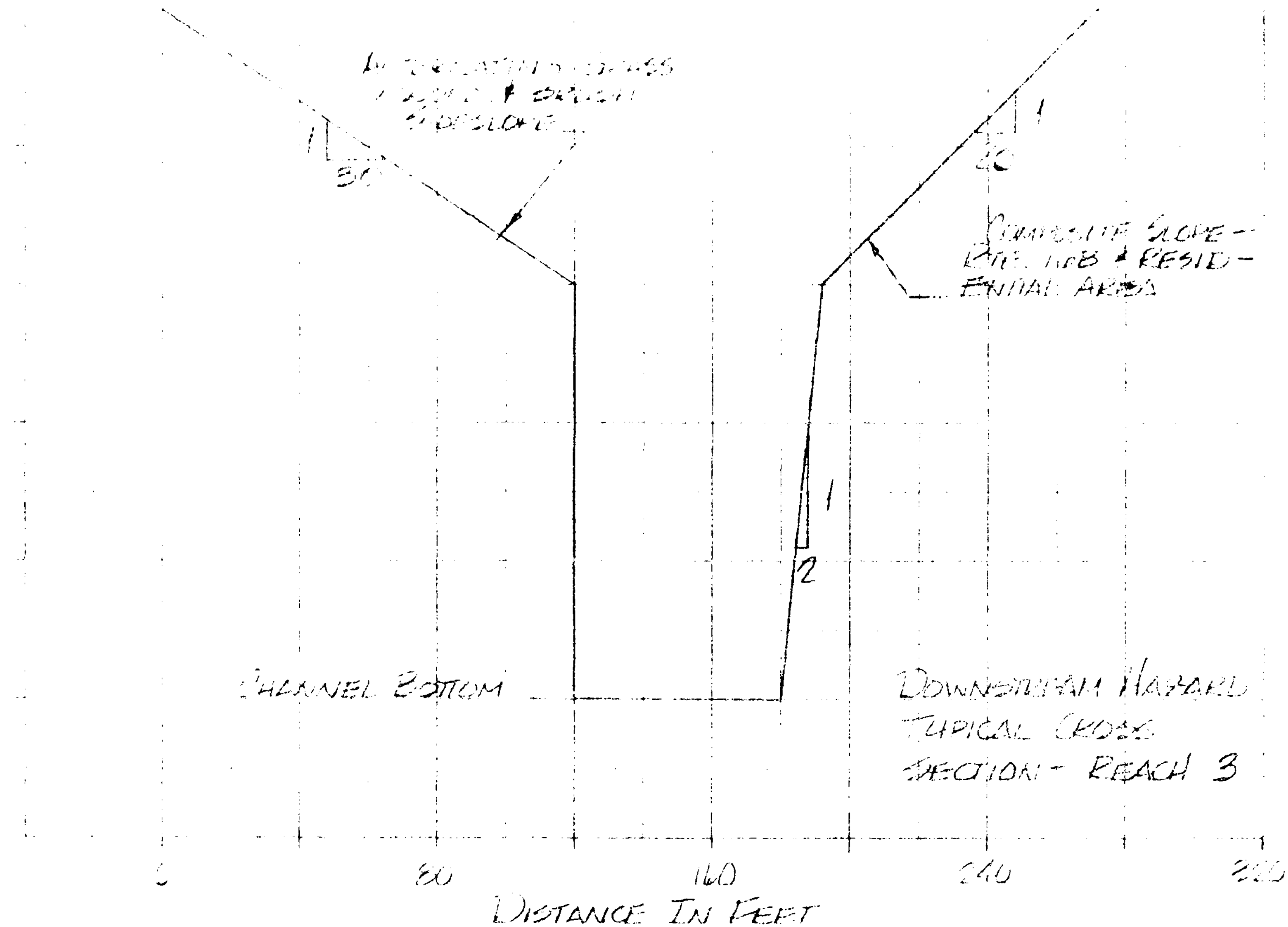
[illegible]	[illegible]	[illegible]	[illegible]
2	124.0	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
8	[illegible]	77.0	[illegible]
10	[illegible]	[illegible]	[illegible]

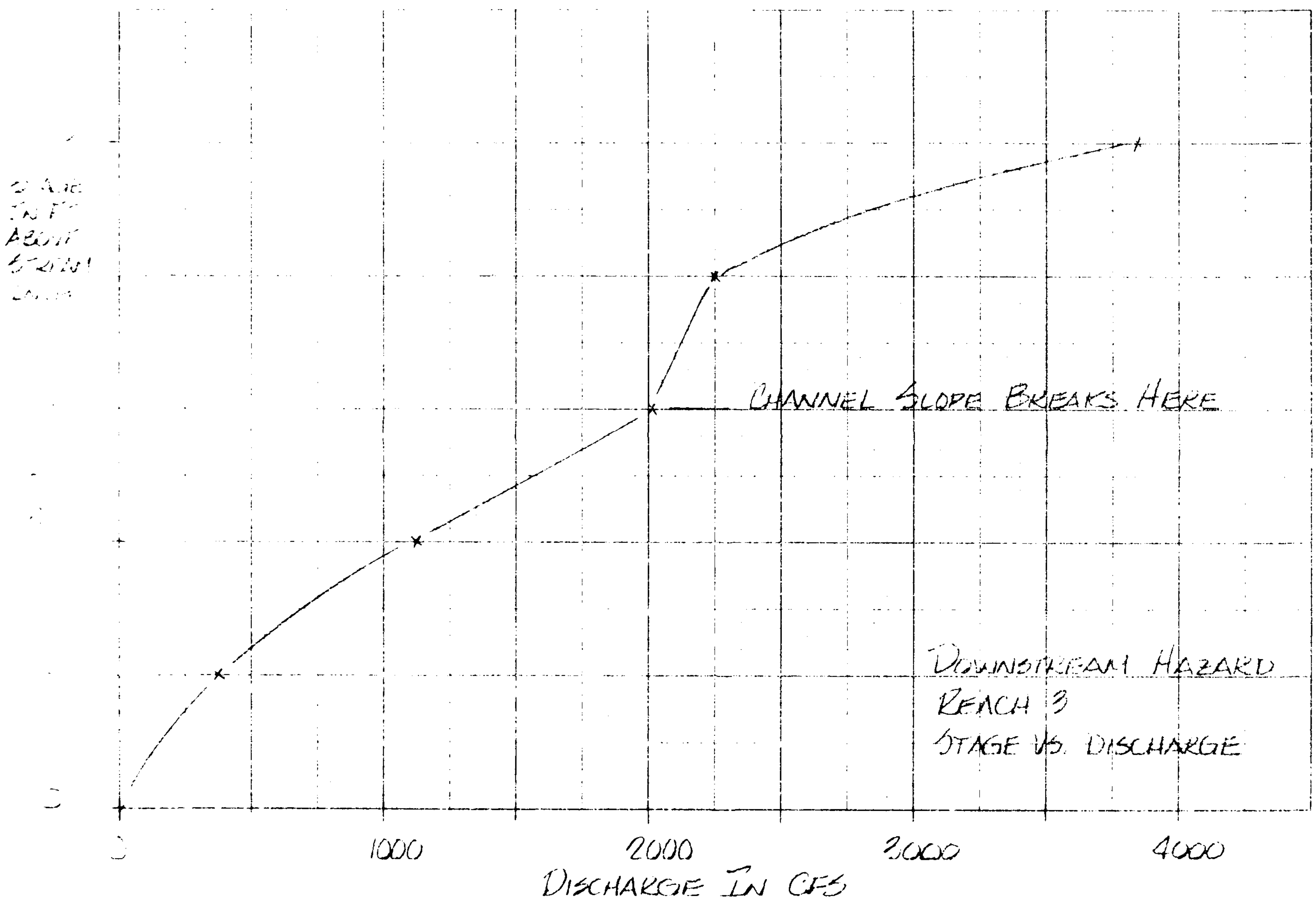
[illegible]

[illegible]

[illegible]

[illegible]


Channel Bottom
Composite Slope -
Resid-
ential Area
Downstream Hazard
Typical Cross
Section - Reach 3
1
30
1
20
1
2
0
80
160
240
Distance In Feet


STAGE IN FT ABOUT STREAM
CHANNEL SLOPE BREAKS HERE
DOWNSTREAM HAZARD
REACH 3
STAGE VS. DISCHARGE
0
1000
2000
3000
4000
DISCHARGE IN CFS

[illegible]
[illegible] Nov 79

[illegible] Analysis Cont.

Analyze [illegible] [illegible] [illegible] culvert [illegible] downstream of [illegible] 3 [illegible] on p. D-32.

Use Manning's Equation to [illegible] flow up to the low chord. $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Slope through culvert $= 0.009$
$n = 0.017$ for concrete walls, 0.05 for channel bottom.

The following table was generated using the Commodore Pet 2001 desk computer. Manning's Equation for open channel flow was programmed into the computer using the data on pp. D-31 & D-33.

Stage in ft. above stream invert	X-sect. area (ft²)	Wetted perimeter	Q (cfs)
2	50.6	29.1	161
4	100.6	33.1	480
6	150.6	37.1	897
8	200.6	41.1	1383

Above a stage of 5.5 [illegible], orifice flow through culvert controls.

$Q = Ca\sqrt{2gh}$ [illegible] = [illegible] [illegible] of culvert

$C^{*} = (1 + 0.4 r^{0.3} + \frac{0.0045 L}{r^{4/3}})^{-1/2}$ $r = \frac{A}{WP} = \frac{[illegible]}{2(25) + 2(8.5)} = 3.7$

$[illegible] (1 + [illegible]^{0.3} + \frac{0.0045\,25}{(3.7)^{4/3}})^{-1/2} = 0.79$

* [illegible], Handbook of Hydraulics

[illegible]

[illegible]
5 Nov 79

BREACH ANALYSIS (CONT.)

① stage = 5.5 feet

$$Q = [illegible] \sqrt{[illegible]} = 2,777 \text{ cfs}$$

② stage = 9.0 feet

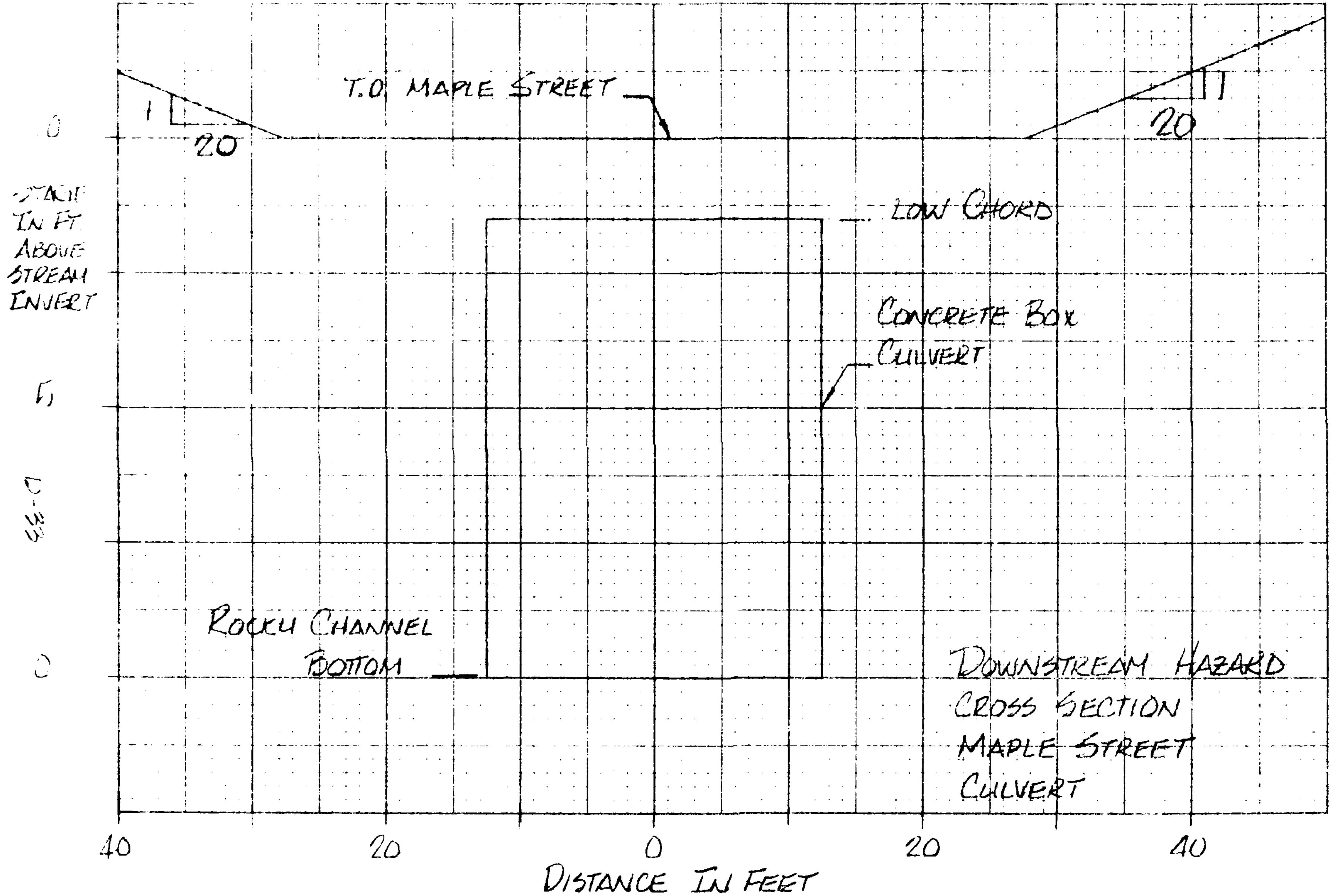
$$Q = 0.19(212.5)\sqrt{29.4[illegible]} = 2326 \text{ cfs}$$

Use the open channel [illegible] to derive the stage-discharge relationship shown on p. D-34.

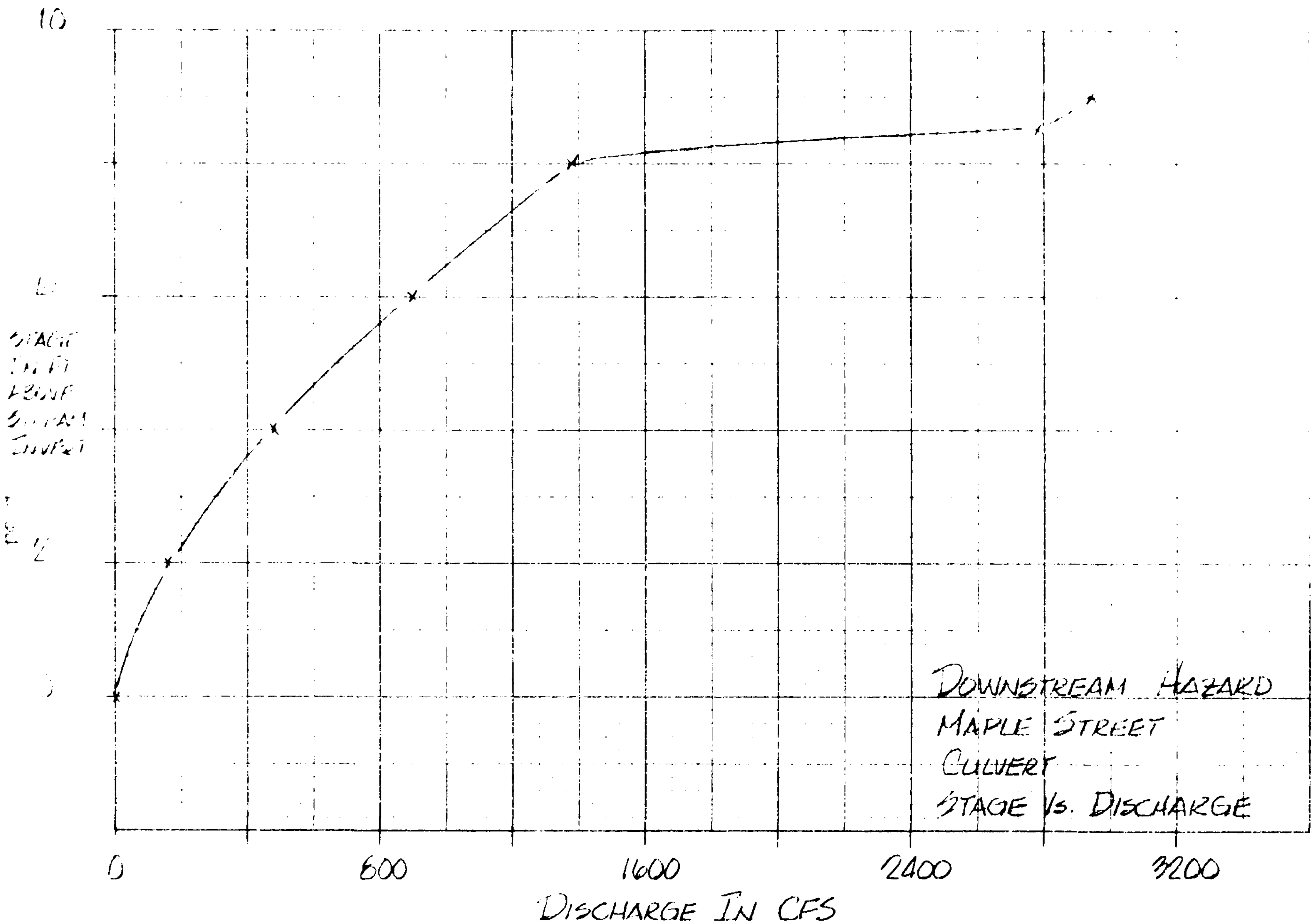
Referring to the rating curve,

① Q_A = 743 cfs, stage = [illegible] feet
② Q_B = 2426 cfs, stage = 8.4 feet

An increase [illegible] of 8.4 - 5.5 = 2.9 feet would occur. The [illegible] will carry the total [illegible] as pressure flow begins to control. [illegible] is not likely to occur and little damage is expected.


T.O. MAPLE STREET
1
20
LOW CHORD
CONCRETE BOX CULVERT
ROCKY CHANNEL BOTTOM
STAGE IN FT ABOVE STREAM INVERT
0
5
DOWNSTREAM HAZARD
CROSS SECTION
MAPLE STREET
CULVERT
40
20
0
20
40
DISTANCE IN FEET

5 NOV 79


10
2
0
600
1600
2400
3200
DISCHARGE IN CFS
DOWNSTREAM HAZARD
MAPLE STREET
CULVERT
STAGE Vs. DISCHARGE

5 NOV 79

14 ... ALL
... NOV 79

BREACH ANALYSIS (CONT.)

Analyze Reach 4 just downstream of the Maple Street bridge.

Use Manning's Equation, $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Slope of stream = 0.005
"n" varies from 0.05 to 0.09

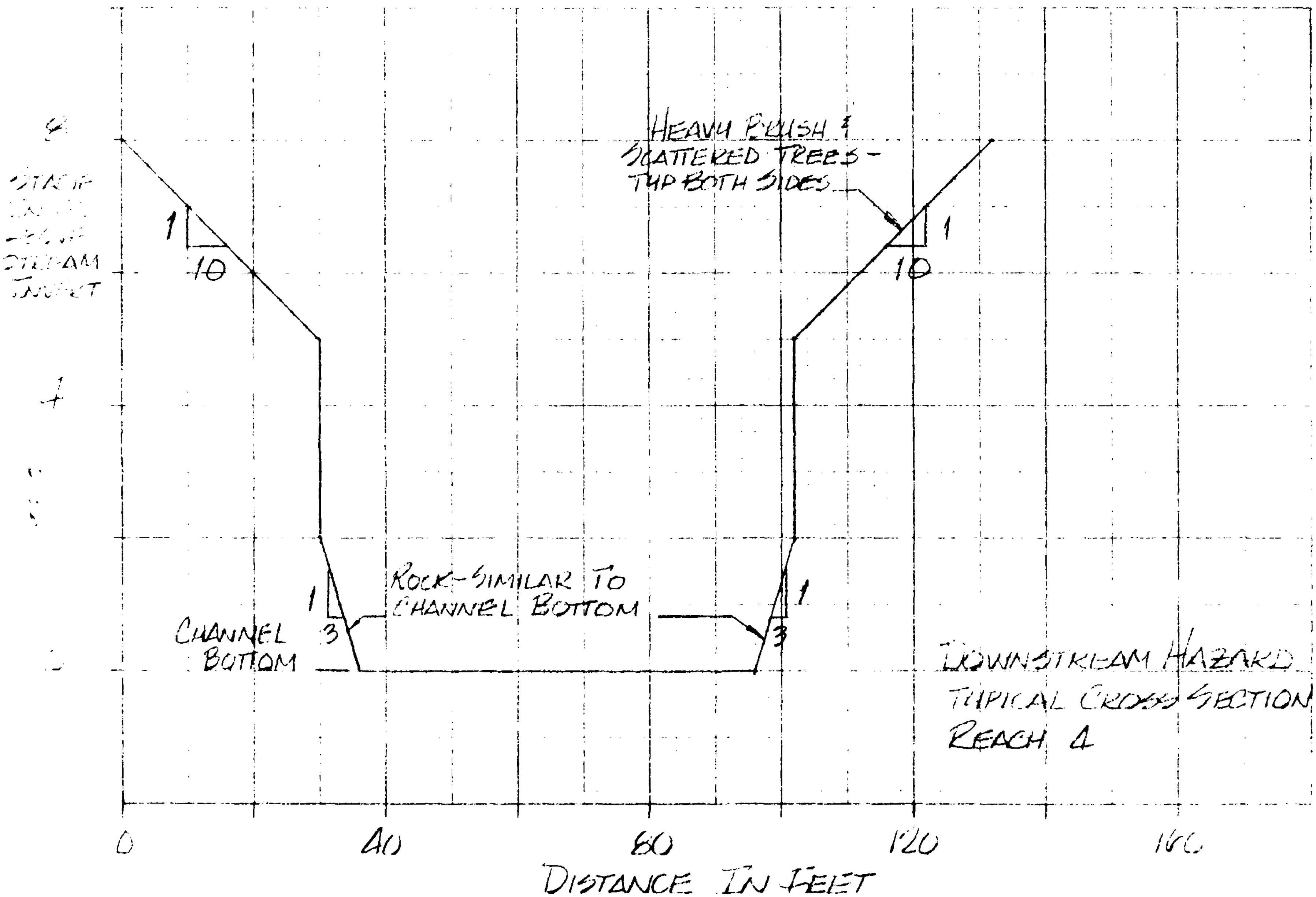
The following table was generated using a ... Pet ... desk computer. Manning's Equation for open channel flow was programmed into the computer using the data on pp. D-35 & D-36.

Stage in ft. above stream invert	X-sect. area (ft²)	wetted perimeter	Q (cfs)
2	132.9	72.7	409
4	276.9	76.7	1325
6	430.8	95.4	2138
8	652.7	137.3	3125

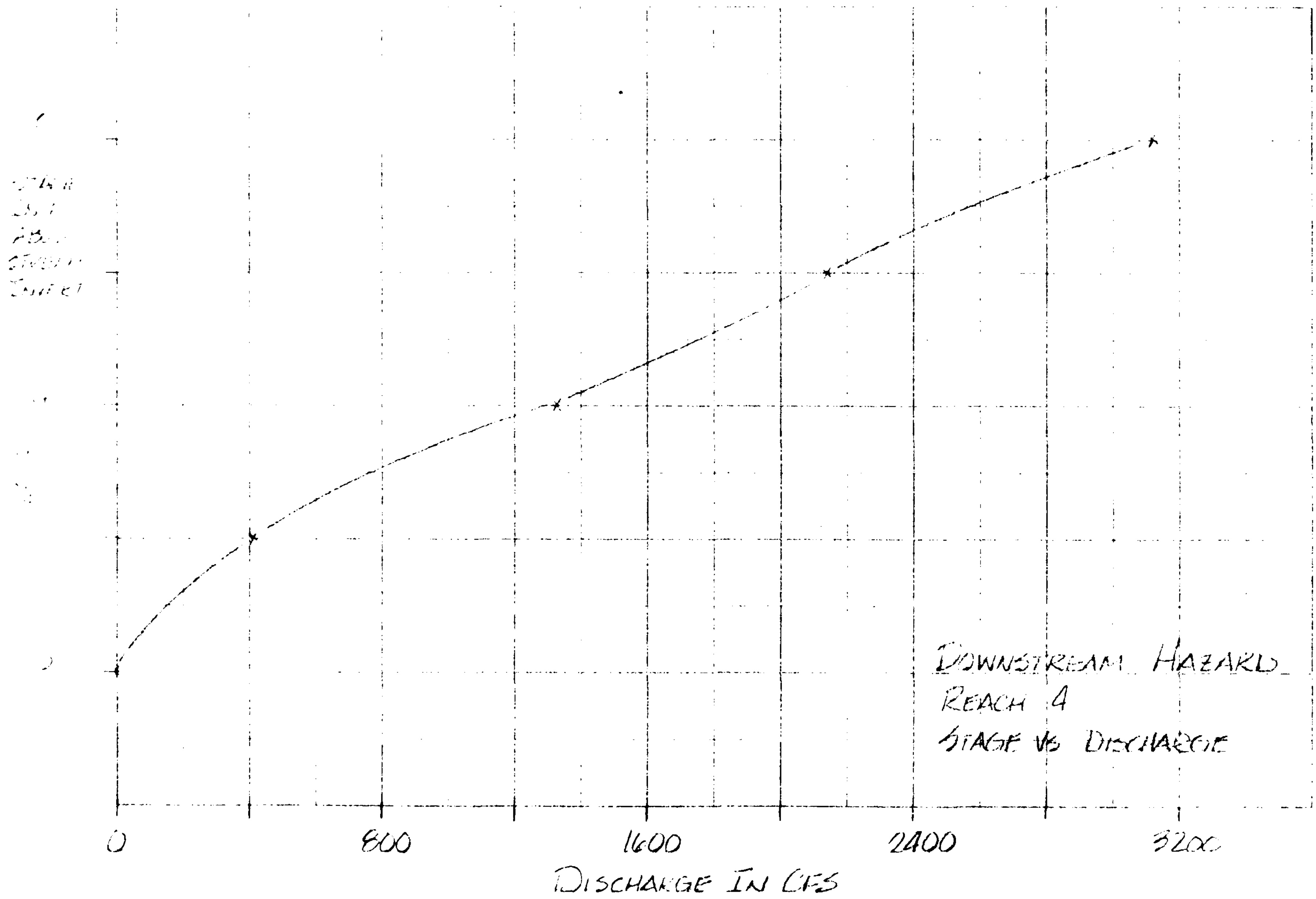
Use the above data to establish the stage-discharge relationship shown on p. D-37. Referring to the rating curve:

$\frac{1}{2}$ Q_A = 743 cfs, stage = 2.9 feet
$\frac{1}{2}$ Q_B = 2428 cfs, stage = 6.8 feet

An increase in stage due to breach of 6.8 - 2.9 = 3.9 feet would result. One ... would be flooded ... 3 feet of water. The other would be subject to less than 1 foot of water. Appreciable property damage could occur. Loss of life would probably not occur.



8
4
0
1
10
HEAVY BRUSH &
SCATTERED TREES -
TYP BOTH SIDES
ROCK-SIMILAR TO
CHANNEL BOTTOM
CHANNEL
BOTTOM
3
0
40
80
120
160
DISTANCE IN FEET
DOWNSTREAM HAZARD
TYPICAL CROSS SECTION
REACH 4



DOWNSTREAM HAZARD
REACH 4
STAGE VS DISCHARGE
0
800
1600
2400
3200
DISCHARGE IN CFS

BREACH ANALYSIS (CONT.)

Conclusion

Three inhabited structures located along Reach 2 would be subject to up to 3 feet of water. Appreciable property damage would result but loss of life would probably not occur.

Some minor flooding (less than [illegible] feet) could occur on the east overbank of the Branch River at Dam "A".

Two inhabited structures located along Reach 4 would be subject to up to [illegible] feet of water. Appreciable property damage would result but loss of life would probably not occur.

In the event of a breach of the [illegible] Dam with the water surface at the top of dam, considerable property damage would likely occur along the reach extending approximately 2000 feet downstream of the dam. Loss of life would probably not occur. Therefore, [illegible] Dam is classified as Significant Hazard.

APPENDIX E

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

8-85

DTIC